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Aerospace Medicine and Biology
A Continuing Bibliography with Indexes

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AEROSPACE MEDICINE AND BIOLOGY

A CONTINUING BIBLIOGRAPHY WITH INDEXES

(Supplement 325)

A selection of annotated references to unclassified reports and journal articles that were introduced into the NASA scientific and technical information system and announced in June 1989 in

- *Scientific and Technical Aerospace Reports (STAR)*
- *International Aerospace Abstracts (IAA).*

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INTRODUCTION

This Supplement to *Aerospace Medicine and Biology* lists 192 reports, articles and other documents announced during June 1989 in *Scientific and Technical Aerospace Reports (STAR)* or in *International Aerospace Abstracts (IAA).* The first issue of the bibliography was published in July 1964.

In its subject coverage, *Aerospace Medicine and Biology* concentrates on the biological, physiological, psychological, and environmental effects to which man is subjected during and following simulated or actual flight in the Earth's atmosphere or in interplanetary space. References describing similar effects on biological organisms of lower order are also included. Such related topics as sanitary problems, pharmacology, toxicology, safety and survival, life support systems, exobiology, and personnel factors receive appropriate attention. In general, emphasis is placed on applied research, but references to fundamental studies and theoretical principles related to experimental development also qualify for inclusion.

Each entry in the bibliography consists of a bibliographic citation accompanied in most cases by an abstract. The listing of the entries is arranged by *STAR* categories 51 through 55, the Life Sciences division. The citations, and abstracts when available, are reproduced exactly as they appeared originally in *IAA* or *STAR,* including the original accession numbers from the respective announcement journals. The *IAA* items will precede the *STAR* items within each category.

Seven indexes — subject, personal author, corporate source, foreign technology, contract, report number, and accession number — are included.

An annual index will be prepared at the end of the calendar year covering all documents listed in the 1989 Supplements.

Information on the availability of cited publications including addresses of organizations and NTIS price schedules is located at the back of this bibliography.

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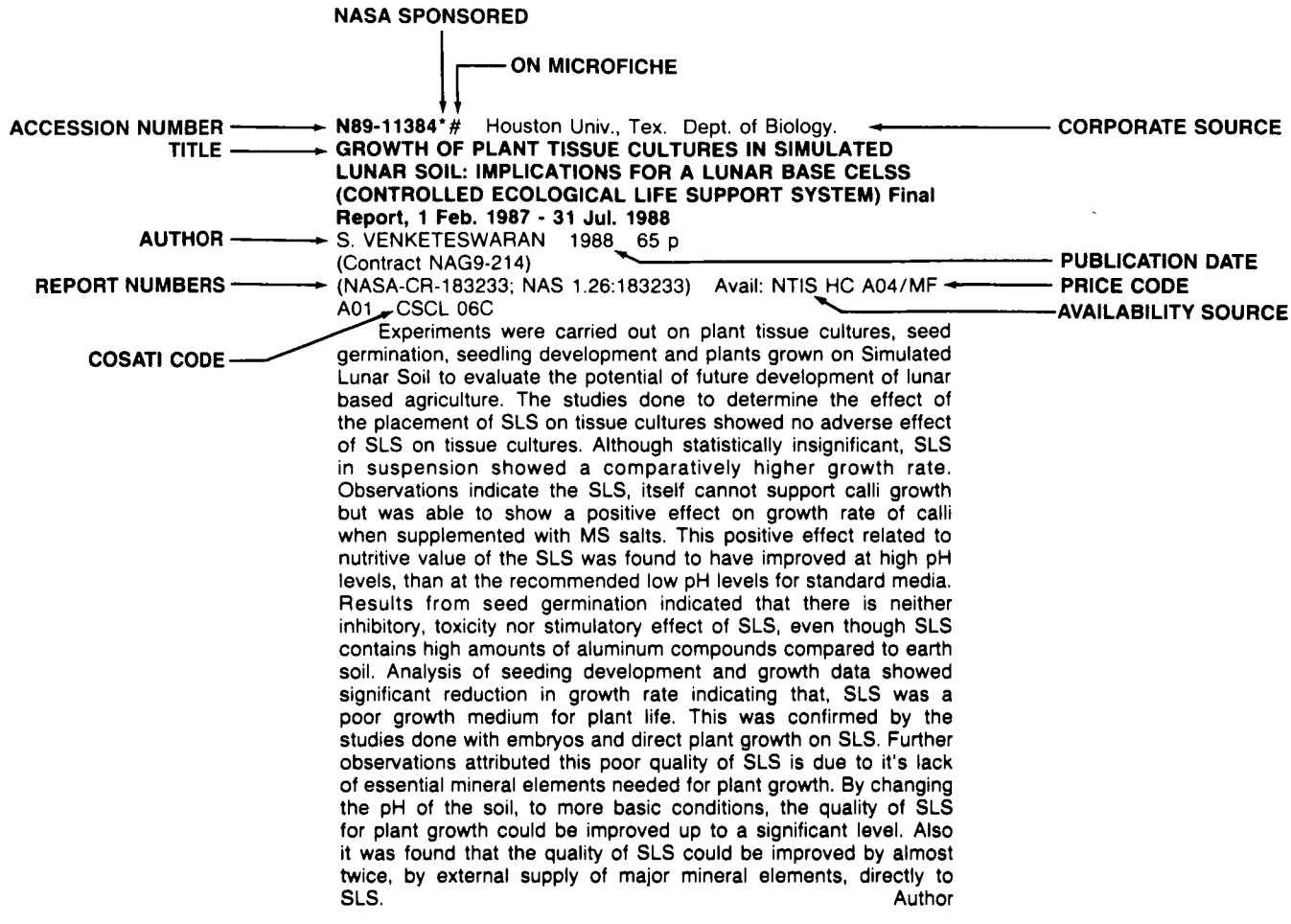
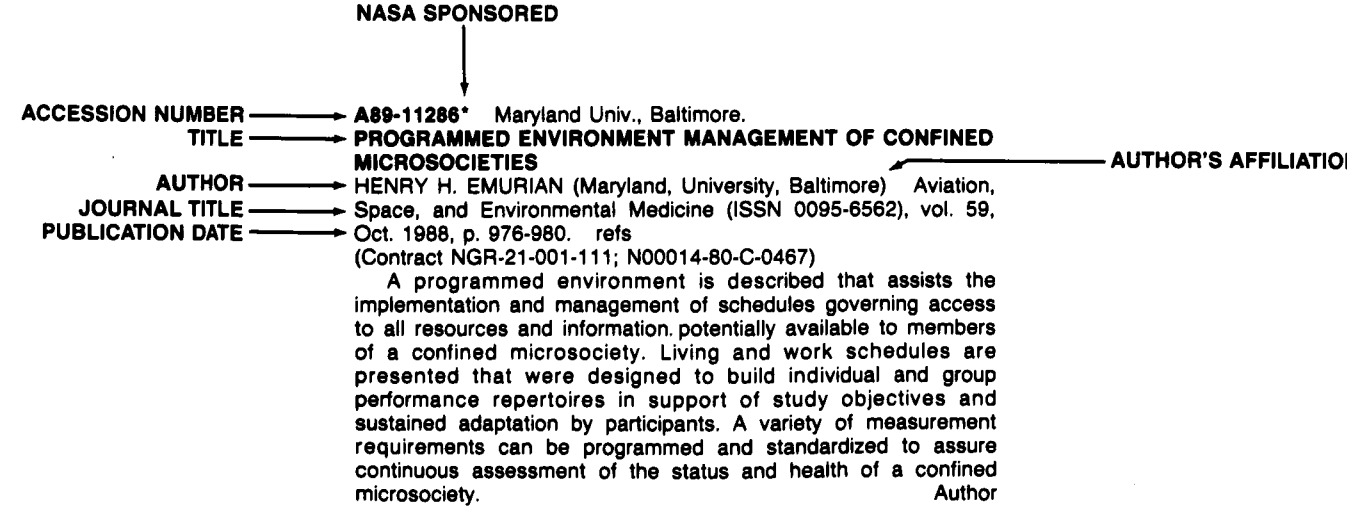
TYPICAL REPORT CITATION AND ABSTRACT



TYPICAL JOURNAL ARTICLE CITATION AND ABSTRACT



AEROSPACE MEDICINE AND BIOLOGY

A Continuing Bibliography (Suppl. 325)

JULY 1989

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LIFE SCIENCES (GENERAL)

A89-29289* Utah State Univ., Logan.
GRAVITROPISM IN HIGHER PLANT SHOOTS. V - CHANGING SENSITIVITY TO AUXIN
FRANK B. SALISBURY, LINDA GILLESPIE, and PATRICIA RORABAUGH (Utah State University, Logan) Plant Physiology (ISSN 0032-0889), vol. 88, 1988, p. 1186-1194. Research supported by Utah State University. refs
(Contract NAG10-0014)

The relationship in plants between the sensitivity to auxin and differential growth and bending was investigated experimentally. Decapitated and marked sunflower hypocotyl sections were immersed in buffered auxin solutions of different concentrations (0, 10 to the -8th, or 0.001 molar) and were photographed at 1/2 hr intervals; the negatives were analyzed with a digitizer/computer to evaluate surface-length changes in terms of Michaelis-Menten enzyme kinetics. It was found that bending decreased with increasing concentration of auxin. Increasing the auxin concentration inhibits the elongation growth of lower surfaces but promotes upper-surface growth, indicating that the lower surfaces have a greater Km sensitivity to applied auxin than the upper surfaces. At optimum auxin levels (maximum growth), the growth of bottom surfaces exceeded that of top surfaces, indicating that bottom tissues had a greater Vmax sensitivity. I.S.

A89-29291* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
CHEMOKINETIC MOTILITY RESPONSES OF THE CYANOBACTERIUM OSCILLATORIA TEREBRIFORMIS
LAURIE L. RICHARDSON (NASA, Ames Research Center, Moffett Field, CA; Oregon, University, Eugene) and RICHARD W. CASTENHOLZ (Oregon, University, Eugene) Applied and Environmental Microbiology (ISSN 0099-2240), vol. 55, Jan. 1989, p. 261-263. refs

Oscillatoria terebriformis, a gliding, filamentous, thermophilic cyanobacterium, exhibited an inhibition of gliding motility upon exposure to fructose. The observed response was transient, and the duration of nonmotility was directly proportional to the concentration of fructose. Upon resumption of motility, the rate of motility was also inversely proportional to the concentration of fructose. Sulfide caused a similar response. The effect of sulfide was specific and not due to either anoxia or negative redox potential. Exposure to glucose, acetate, lactate, or mat interstitial water did not elicit any motility response. Author

A89-29302* Beth Israel Hospital, Boston, MA.
FRACTALS IN PHYSIOLOGY AND MEDICINE
ARY L. GOLDBERGER (Beth Israel Hospital, Boston, MA) and BRUCE J. WEST (Physical Dynamics, Inc., La Jolla, CA) Yale Journal of Biology and Medicine (ISSN 0044-0086), vol. 60, 1987, p. 421-435. Research supported by NASA and Whitaker Health Sciences Fund. refs
(Contract F33615-87-C-0538)

The paper demonstrates how the nonlinear concepts of fractals, as applied in physiology and medicine, can provide an insight into the organization of such complex structures as the tracheobronchial tree and heart, as well as into the dynamics of healthy physiological variability. Particular attention is given to the characteristics of computer-generated fractal lungs and heart and to fractal pathologies in these organs. It is shown that alterations in fractal scaling may underlie a number of pathophysiological disturbances, including sudden cardiac death syndromes. I.S.

A89-30071
HEMODYNAMICS IN EMOTIONAL RESPONSES AND IN EMOTIONAL STRESS [GEMODINAMIKA PRI EMOTSIONAL'NYKH REAKTSIIAKH I EMOTSIONAL'NOM STRESSE]
K. V. SUDAKOV, E. A. IUMATOV, and L. S. UL'IANINSKII (AMN SSSR, Nauchno-Issledovatel'skii Institut Normal'noi Fiziologii, Moscow, USSR) Fiziologicheskii Zhurnal SSSR (ISSN 0015-329X), vol. 74, Nov. 1988, p. 1535-1545. In Russian. refs

Changes in hemodynamics caused by emotional stress induced with electrical stimulation of the ventromedial hypothalamus (VMH) or with behavioral conflicts (forced immobilization) were investigated in rats fitted with a catheter in the tail artery. It was found that negative emotional states were followed by pressor-depressor vascular responses, with vascular responses to the VMH being mostly of the pressor character. Under immobilization stress, changes in vascular tonus were shown to play a major role in the progressive fall in arterial pressure. I.S.

A89-30072
FUNCTIONAL CONDITION OF THE POSITIVE EMOTIOGENIC STRUCTURES OF THE HYPOTHALAMUS UNDER ARTERIAL HYPERTENSION [FUNKTSIONAL'NOE SOSTOIANIE POLOZHITEL'NYKH EMOTSIOGENNYKH STRUKTUR GIPOTALAMUSA PRI ARTERIAL'NYKH GIPERTENZIIAKH]
O. G. BAKLAVADZHIAN, A. G. DARBINIAN, and I. KH. TATURIAN (AN ASSR, Institut Fiziologii, Yerevan, Armenian SSR) Fiziologicheskii Zhurnal SSSR (ISSN 0015-329X), vol. 74, Nov. 1988, p. 1554-1563. In Russian. refs

The effects of acute and chronic arterial hypertension on the positive emotiogenic structures of the hypothalamic 'reward zone' were investigated in cats and rats, each fitted with four bipolar microeletrodes in the posterior hypothalamus and trained to press a pedal to evoke a positive electrostimulus. It was found that, while small doses of noradrenaline facilitated the self-stimulation reaction (pedal pressing), large doses, which caused an obvious increase in blood pressure, depressed or stopped it. A fall of arterial pressure caused by catapresan injections resulted in a temporary recovery of the self-stimulation reaction. I.S.

A89-30073
AN INCREASE IN THE STRUCTURAL COMPONENT OF THE VASCULAR BED RESISTANCE UNDER HYPERTENSION AND ITS REGULATORY CONSEQUENCES [UVELICHENIE STRUKTURNOGO KOMPONENTA SOPROTIVLENIIA KROVENOSNOGO RUSLA PRI GIPERTENSII I EGO REGULIATORNYE POSLEDSTVIIA]
I. M. RODIONOV, T. B. ALEKSANDROVA, I. A. SOKOLOVA, O. S. TARASOVA, and V. B. KOSHELEV (Moskovskii Gosudarstvennyi

Universitet, Moscow, USSR) Fiziologicheskii Zhurnal SSSR (ISSN 0015-329X), vol. 74, Nov. 1988, p. 1580-1587. In Russian. refs

A89-30075
BEHAVIORAL AND METABOLIC CHARACTERISTICS IN SPONTANEOUSLY HYPERTENSIVE RATS [POVEDENCHESKIE I METABOLICHESKIE OSOBENNOSTI SPONTANNO GIPERTENZIVNYKH KRYS]
A. A. BACHMANOV, IU. S. DMITRIEV, and L. S. MASLENNIKOVA (AN SSSR, Institut Fiziologii, Leningrad, USSR) Fiziologicheskii Zhurnal SSSR (ISSN 0015-329X), vol. 74, Nov. 1988, p. 1677-1683. In Russian. refs

The behavioral patterns of spontaneously hypertensive (SHR-line) rats were compared with those of normotensive Wistar rats. It was found that, in the hypertensive rats, the overall daily activity, the activity associated with alternating illumination, and the behavioral activity associated with exploratory motivation were higher, whereas the activity associated with fear motivation was lower. The 20-week-old SHR rats also had a higher total oxygen consumption and lower pO2 and blood circulation velocity in the sensomotor area of the brain than the normotensive rats. On the other hand, at 12 weeks of age, no difference in oxygen metabolism was found, indicating that the decreases in the oxygen supply appearing at 20 weeks are not related to behavioral changes occurring at the early stages of hypertension. I.S.

A89-30181
MODULATING THE FAST-MUSCLE-FIBER RESTING POTENTIAL WITH ALPHA-TOCOPHEROL IN RATS ADAPTED TO COLD [MODULIROVANIE ALPHA-TOKOFEROLOM MEMBRANNOGO POTENTSIALA POKOIA BYSTROGO MYSHECHNOGO VOLOKNA KRYSY PRI ADAPTATSII K KHOLODU]
G. P. BELOUSOVA (Petrozavodskii Gosudarstvennyi Universitet, Petrozavodsk, USSR) Fiziologicheskii Zhurnal SSSR (ISSN 0015-329X), vol. 74, Oct. 1988, p. 1476-1479. In Russian. refs

The effect of an antioxidant (alpha-tocopherol) on the resting membrane potential (RMP) of fast muscle fibers during adaptation to cold was investigated in rats kept at -1 to -15 C for four weeks. Alpha-tocopherol (50 mg/kg) was injected to room-temperature controls and to one group of adapted animals every other day for 4 weeks; the other group was also preinjected (before cold exposure) with tocopherol. The RMP was measured in situ by intracellularly inserted microelectrodes. It was found that rats subjected to a cold environment exhibited lower (by about 11.7 mV) values of RMP, indicating that tocopherol promotes the stabilization of muscle membranes. I.S.

A89-30240
EXPERIMENTAL PROOF OF THE EXISTENCE OF A PARALLEL DOUBLE DNA HELIX [EKSPERIMENTAL'NOE DOKAZATEL'STVO SUSHCHESTVOVANIIA PARALLEL'NOI DVOINOI SPIRALI DNK]
A. K. SHCHELKINA, IU. P. LYSOV, I. A. IL'ICHEVA, A. A. CHERNYI, IU. B. GOLOVA (AN SSSR, Institut Molekuliarnoi Biologii, Moscow, USSR) et al. Akademiia Nauk SSSR, Doklady (ISSN 0002-3264), vol. 304, no. 2, 1989, p. 476-480. In Russian. refs

It is demonstrated experimentally that oligodeoxyribonucleotides consisting of natural monomeric units can form a double helix with a parallel arrangement of links under conditions close to physiological ones. The thermodynamics of the formation of the parallel structure is examined, and spectra of the parallel structure are presented. B.J.

A89-30241
EFFECT OF HYPERTHERMIA ON THE SYNTHESIS OF CATECHOLAMINES IN ISOLATED ORGANS [EFFEKT GIPERTERMII NA SINTEZ KATEKHOLAMINOV V IZOLIROVANNYKH ORGANAKH]
B. N. MANUKHIN, KH. A. MEZIDOVA, B. K. SHAIYMOV, and F. F. SULTANOV (AN SSSR, Institut Biologii Razvitiia, Moscow, USSR; AN TSSR, Institut Fiziologii i Eksperimental'noi Patologii Aridnoi Zony, Ashkhabad, Turkmen SSR) Akademiia Nauk SSSR, Doklady (ISSN 0002-3264), vol. 304, no. 2, 1989, p. 498-501. In Russian. refs

A89-30281
LATEST PROTEROZOIC PLANKTON FROM THE AMADEUS BASIN IN CENTRAL AUSTRALIA
W. L. ZANG (Australian National University, Canberra, Australia) and M. R. WALTER (Bureau of Mineral Resources, Geology and Geophysics, Canberra, Australia) Nature (ISSN 0028-0836), vol. 337, Feb. 16, 1989, p. 642-645. refs

In recent studies of the diversity of Proterozoic and early Paleozoic acritarchs, a gradual increase in diversity from the Middle into the Late Proterozoic has been shown to be followed by a sharp decrease in diversity in the latest Proterozoic (Ediacarian or Vendian) and then a rise again in the early Cambrian. The discovery of a diverse assemblage of large and morphologically complex acritarchs from the Ediacarian age upper Pertatataka Formation in the Amadeus Basin of central Australia is reported. This, together with a recent report of similar fossils from the upper Sinian of China, provides a significant new perspective on the history of the plankton. It is now necessary to suggest an earlier radiation, at least in offshore environments, or to question the reality of the postulated decrease in diversity. In addition, there may well have been an extinction event late in the Ediacarian. C.D.

A89-32216
FUNCTIONAL AND STRUCTURAL FEATURES OF THE ADAPTATION OF THE HEART TO STATIC PHYSICAL LOADS [FUNKTSIONAL'NO-STRUKTURNYE OSOBENNOSTI ADAPTATSII SERDTSA K FIZICHESKIM NAGRUZKAM STATICHESKOGO KHARAKTERA]
L. A. GNATIUK, V. I. IL'NITSKII, and M. S. GNATIUK (Ternopol'skii Gosudarstvennyi Meditsinskii Institut, Ternopol, Ukrainian SSR) Fiziologicheskii Zhurnal SSSR (ISSN 0015-329X), vol. 75, Jan. 1989, p. 52-57. In Russian. refs

The functional state (as evaluated from ECG indices) and the morphometric characteristics of the cardiovascular system of rats were studied during the process of adaptation to a static physical load. It was found that, in 47 percent of the animals, the cardiac mass increased due to the right ventricle hypertrophy, while a predominant increase of the left ventricle was found in only 17 percent of the rats; an equal hypertrophy of both ventricles was observed in 31 percent of the animals. The remaining animals experienced no change in cardiac mass. The results of the cardiac rhythm analysis for these animals indicated that the adaptive rearrangements of the myocardium caused individually different characteristics of the cardiac rhythm regulation. I.S.

A89-32217
INVESTIGATION OF THE CENTRAL MECHANISMS OF THERMOREGULATION AND THEIR RELATIONSHIP TO PHASE TRANSITIONS OF BRAIN LIPIDS [ISSLEDOVANIE TSENTRAL'NYKH MEKHANIZMOV TERMOREGULIATSII I OTNOSHENIIA K NIM FAZOVYKH PEREKHODOV LIPIDOV MOZGA]
V. V. TSARIUK and A. I. KUBARKO (Minskii Gosudarstvennyi Meditsinskii Institut, Minsk, Belorussian SSR) Fiziologicheskii Zhurnal SSSR (ISSN 0015-329X), vol. 75, Jan. 1989, p. 97-104. In Russian. refs

Experiments in rats and rabbits were conducted to investigate the relationships among the body temperature, the functional activity of brain, and the temperature of phase transitions of brain lipids. In animals whose body temperature was raised experimentally, an increased activity of thermosensitive neurons coincided with increases in the peripheral temperature threshold and the phase transition temperature of brain lipids. The phospholipids of hypothalamic tissues were found to exhibit an increased level of saturated fatty acid radicals. I.S.

A89-32218
HORMONAL HOMEOSTASIS AND INTRAOCULAR PRESSURE IN CHRONIC EMOTIONAL STRESS CAUSED BY STIMULATING THE AMYGDALA [GORMONAL'NYI GOMEOSTAZ I VNUTRIGLAZNOE DAVLENIE PRI KHRONICHESKOM EMOTSIONAL'NOM STRESSE, VYZVANNOM VOZDEISTVIIAMI NA MINDALEVIDNYI KOMPLEKS]
L. S. ISAKOVA, G. E. DANILOV, S. B. EGORKINA, and E. G. BUTOLIN (Izhevskii Gosudarstvennyi Meditsinskii Institut, Izhevsk, USSR) Fiziologicheskii Zhurnal SSSR (ISSN 0015-329X), vol. 75, Jan. 1989, p. 124-130. In Russian. refs

The effects of stimulating rabbit amygdala by angiotensin-II injections or by electric stimuli on the intraocular pressure, the eye hydrodynamics, and the blood concentrations of hypophyseal, thyroidal, adrenal, and pancreatic hormones were investigated. The stimulation of amygdala caused a hypersecretion of intraocular fluid, which in turn caused an elevation of intraocular pressure. The concentrations of most hormones were found to be significantly altered as the result of stimulation, indicating changes in the hormonal homeostasis. Administering angiotensin to electrically stimulated amygdala was found to further increase changes in all measured indices of emotional stress. I.S.

A89-32342
EFFECTS OF DIPYRIDAMOLE ON THE CARDIOVASCULAR RESPONSE TO +GZ STRESS IN MINIATURE SWINE
D. FRED PETERSON (Oral Roberts University, Tulsa, OK), JOHN W. BURNS, JOHN W. FANTON (USAF, School of Aerospace Medicine, Brooks AFB, TX), and HAROLD M. LAUGHLIN (Missouri, University, Columbia) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 60, March 1989, p. 218-225. refs
(Contract F33615-85-4524; NIH-HL-36088; NIH-HL-01774)

Eight conscious female miniature swine experienced acceleration levels of 3, 5, and 7 +Gz before and after infusion of dipyridamole (1-2 mg/kg). Each animal was instrumented to measure ECG, heart level arterial pressure (AP), eye level arterial pressure (ELBP), left atrial pressure (LAP), heart rate (HR), and regional tissue blood flows. Each was also fitted with an abdominal anti-G suit which automatically inflated. Dipyridamole infusion had no direct effect on HR or LAP, but AP was significantly reduced. All cardiovascular responses to +Gz were qualitatively similar before and after dipyridamole. Tachycardia always occurred. AP and CNS blood flow were maintained better prior to dipyridamole, and AP always fell in proportion to acceleration intensity. +Gz was generally associated with increased blood flow to respiratory muscles and heart and decreased blood flow throughout the viscera and to the eyes. ELBP paralleled AP, but was always lower in direct proportion to the +Gz level. It is concluded that dipyridamole reduces arterial pressure, thus compromising the ability of the animal to sustain cerebral perfusion pressure (ELBP) during +Gz. Author

A89-32343* California Univ., Los Angeles.
EXERCISE EFFECTS ON THE SIZE AND METABOLIC PROPERTIES OF SOLEUS FIBERS IN HINDLIMB-SUSPENDED RATS
SCOT C. GRAHAM, ROLAND R. ROY, STEVE P. WEST, DON THOMASON, and KENNETH M. BALDWIN (California, University, Los Angeles and Irvine) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 60, March 1989, p. 226-234. refs
(Contract NIH-NS-16333; NCA2-IR-390-502)

The effects of four-week-long hind-limb suspension (HS) of rats on the size the soleus muscle fibers and the activity of succinate dehydrogenase (SDH) in dark and light ATPase fibers were investigated together with the efficacy of an endurance exercise (EX) program (daily treadmill exercise for 1.5 h/day at 20 m/min and a 30-percent grade) in ameliorating HS-induced changes. It was found that, in comparison to age-matched controls, the soleus wet weight decreased by 69 and 30 percent in HS and HS-EX rats, respectively, and the percent of dark ATPase fibers increased from 10 percent in controls to 19 and 17 percent, respectively. The values of the integrated fiber activity (activity/min times muscle area) showed a net loss of SDH in both the light and dark ATPase fibers of HS rats, but only in the light ATPase fibers of the HS-EX rats, indicating that exercise ameliorated but did not prevent the muscle fiber atrophy induced by HS. I.S.

A89-32344
ERYTHROCYTE AGGLUTINATION IN MICROGRAVITY
R. T. MOREHEAD, T. A. OLSEN, E. H. DRAKE, and M. MUCKERHEIDE (Wausau Hospital Center; A. Ward Ford Memorial Institute, Wausau; Saint Mary's Hospital, Milwaukee, WI) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 60, March 1989, p. 235-240. Research supported by the A. Ward Ford Memorial Institute. refs

This experiment tested a self-contained blood grouping device under microgravity as well as the possibility that gravity could affect the blood grouping reaction. The experiment tested Rh, ABO, and Coombs-sensitized human erythrocytes against their appropriate antisera and diluents. A self-contained device was built which accomplished the agglutination and collected the agglutinates on filter paper. This was flown on the Columbia Space Shuttle on Jan. 12, 1986. The device produced blood agglutinates to several blood groups and the agglutinates were held on filter paper until returned by NASA as soon as practical after landing. Both the Rh test and Rh control systems failed because of crystallization within the tubing. The remaining three systems functioned as expected. After comparing these results to similar experiments conducted under full gravity, it is concluded that ABO and Coombs-sensitized blood grouping tests do occur under microgravity, although the agglutinates formed may be smaller. The use of a closed system for clinical laboratory examination in space is demonstrated. Author

A89-32345
MODULATION OF HUMAN PLASMA FIBRONECTIN LEVELS FOLLOWING EXERCISE
D. A. DUBOSE, L. E. ARMSTRONG, W. J. KRAEMER, and M. LUKASON (U.S. Army, Institute of Environmental Medicine, Natick; Integrated Genetics, Framingham, MA) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 60, March 1989, p. 241-245. refs

The potential of exercise as a means of increasing circulating plasma fibronectin (PF) concentrations in humans was evaluated in subjects undergoing short-term (1 week) or long-term (12 weeks) exercise programs (STE and LTE, respectively), which for the STE subjects consisted in treadmill running at 41 C. The LTE subjects were divided into four groups. Two groups exercised by running combined with either full-body or upper-body weight training, while the other two groups exercised by either running only or uppper-body weight training only. It was found that the PF concentration was increased in STE and in all LTE groups. However, in LTE groups, the PF concentration was intermittently suppressed (at four or eight weeks) before an elevation occurred after 12 weeks, indicating that STE may be a more appropriate approach to the elevation of PF with exercise. I.S.

N89-19104# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Cologne (Germany, F.R.). Inst. fuer Raumsimulation.
SECOND SUMMER SCHOOL ON MICROGRAVITY. 2: LIFE SCIENCES AS MAIN SUBJECT [VORTRAGSKURZFASSUNGEN DER 2. SOMMERSCHULE MIKROGRAVITATION (SCHWERPUNKT LEBENSWISSENSCHAFTEN)]
G. OTTO, ed. Jun. 1988 187 p Partly in ENGLISH and GERMAN Summer school held in Cologne, Fed. Republic of Germany, 27-30 Jun. 1988
(DFVLR-IB-333-88/7; ETN-89-93515) Avail: NTIS HC A09/MF A01

Weightlessness induced effects on human and animal biology were discussed. Biological reactions of systems to extraterrestrial conditions, radiation, gravity, acceleration, temperature and pressure are described. Biological and medical results obtained

by D1-mission are presented together with the MUSC, microgravity user support center and other supports. ESA

N89-19111# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Cologne (Germany, F.R.). Inst. fuer Flugmedizin.
DEVELOPMENT OF ANIMALS [ENTWICKLUNG VON TIEREN]
W. BRIEGLEB *In its* Second Summer School on Microgravity. 2: Life Sciences as Main Subject p 101-110 Jun. 1988 In GERMAN
Avail: NTIS HC A09/MF A01

Ontogenetic and phylogenetic aspects of animal development are discussed, and gravity effects on biologic receptors are analyzed. The smallest functional units' perception mechanism is studied in presence or absence of density differences. Hypotheses on gravity induced information reception by the cells are formulated. ESA

N89-19112# Bonn Univ. (Germany, F.R.). Botanisches Inst.
GRAVITY SENSITIVITY: MAIN PROBLEM IN GRAVITATIONAL BIOLOGY [SCHWERKRAFTWAHRNEHMUNG: ZENTRALES PROBLEM DER GRAVITATIONSBIOLOGIE]
D. VOLKMANN *In* DFVLR, Second Summer School on Microgravity. 2: Life Sciences as Main Subject p 111-122 Jun. 1988 In GERMAN
Avail: NTIS HC A09/MF A01

Gravity signal transformation by biologic cells is studied as a main orientation factor in exobiology. Factors involved in signal transformation are analyzed for plants and animals. Plant culture hardware and payload operating plans for spaceflight are described. ESA

N89-19113# Johann-Wolfgang-Goethe-Univ., Frankfurt am Main (Germany, F.R.). Inst. fuer Mikrobiologie.
CELL BIOLOGY AND BIOTECHNOLOGY UNDER REDUCED GRAVITY CONDITIONS [ZELLBIOLOGIE UND BIOTECHNOLOGIE UNTER MIKROGRAVITATIONSBEDINGUNGEN]
HORST-DIETER MENNIGMANN *In* DFVLR, Second Summer School on Microgravity. 2: Life Sciences as Main Subject p 123-132 Jun. 1988 In GERMAN
Avail: NTIS HC A09/MF A01

Sensitivity of one cell organisms to reduced gravity is studied for the determination of bioreactors to use in biotechnology. Gravitation effects on evolution and cell biology of protozoa are discussed, and experiments performed in bioastraunotics are summarized. Genetic engineering and electrofusion are the main research fields for orbital biotechnology. ESA

N89-19118# Sira Inst. Ltd., Chislehurst (England). Research and Development Div.
THIN LAYER CHROMATOGRAPHY STUDY Final Report
R. J. SIMPSON and J. A. GAWTHORPE Paris, France ESA 21 Oct. 1987 64 p
(Contract ESTEC-6898/86-NL-PB)
(SIRA-A/7886/00; ESA-CR(P)-2672; ETN-89-93927) Avail: NTIS HC A04/MF A01

The potential use of thin layer chromatography (TLC) in space, particularly for life sciences and crew health monitoring is discussed. The automation of the method is considered, and a design for a breadboard model given. The TLC method is compared with high pressure liquid chromatography and the dry chemistry method. The TLC method is shown to be superior for microgravity and other spaceborne conditions. ESA

N89-19795# National Lab. for High Energy Physics, Oho (Japan).
RADIATION BIOLOGY STUDIES IN SOFT X-RAY AND ULTRASOFT X-RAY REGION
KATSUMI KOBAYASHI, ed. Feb. 1988 50 p In JAPANESE Presented at the Workshop on Radiation Biology Studies in Soft X-ray and Ultrasoft X-ray Region, Tsukuba, Japan, 17 Jun. 1987 (DE88-756071; KEK-87-29; CONF-8706364) Avail: NTIS (US Sales Only) HC A03/MF A01

The aim of the radiation biology group in the PF is to investigate into the radiation biological effect of monochromatic SR light from ultraviolet to X-ray region, and to clarify the mechanism of biological action of radiation including corpuscular beam and gamma ray, in particular, its initial process. As the requirement for the purpose, the equipment of irradiating the monochromatic SR light over the whole region on living things and the room for specimen preparation and effect test, in which the radioisotopes indispensable for elucidating the responding process of living things can be used, have been made to be ready for use. Two irradiation systems for the monochromatic X-ray from 0.8 A to 3 A and the monochromatic soft X-ray from 4 A to 7 A were provided. Besides, an oblique incidence spectroscope for the ultrasoft X-ray from 40 A to 400 A region is equipped. By the combined use with a vacuum irradiation equipment, the above mentioned aim approaches one step closer to the realization. Especially, the soft X-ray irradiation system is expected to contribute to the research on the mechanism of causing DNA injury and the response to it. The study meeting was held on June 17 and 18, 1987, and the reports are collected in this book. DOE

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AEROSPACE MEDICINE

Includes physiological factors; biological effects of radiation; and effects of weightlessness on man and animals.

A89-29308* Beth Israel Hospital, Boston, MA.
AGE-RELATED DISAPPEARANCE OF MAYER-LIKE HEART RATE WAVES
W. R. JARISCH, J. J. FERGUSON, R. P. SHANNON, J. Y. WEI, and A. L. GOLDBERGER (Beth Israel Hospital, Boston, MA) Experientia (ISSN 0014-4754), vol. 43, 1987, p. 1207-1209. Research supported by NASA. refs

The effect of age on the principal spectral components of heart rate obtained immediately after passive upright tilt was investigated in human subjects who underwent a 60-deg tilt over 9 sec. Two groups were examined, the first of which consisting of healthy male subjects aged 22-26 years, while the second was comprised of subjects aged 65-84 years on no medication; radiograms were recorded continuously beginning just prior to tilt until 3 min posttilt. The results of spectral analysis showed that elderly subjects did not exhibit the Mayer-like heart rate waves (the 0.07-0.09 Hz oscillations) that were present in the spectra of young subjects immediately after passive upright tilt. The findings are consistent with the concept of a 'dysautonomia of aging'. It is suggested that postural stress testing with spectral analysis of heart rate fluctuations may provide a useful way of assessing physiologic vs chronologic age. I.S.

A89-29322* National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
RADIATION SAFETY IN COMMERCIAL AIR TRAFFIC - A NEED FOR FURTHER STUDY
JOHN W. WILSON and LAWRENCE W. TOWNSEND (NASA, Langley Research Center, Hampton, VA) Health Physics (ISSN 0017-9078), vol. 55, Dec. 1988, p. 1001-1003. refs

The problem of radiation exposure of crewmembers in high altitude supersonic commercial aircraft is addressed. As a result of recent changes in the quality factors for radiological protection, it is found that worst case estimates of radiation exposure are now well above the exposure limits of the general population, and a reassessment of radiation impact on commercial aviation is needed, if the proposed quality factors are adopted. Calculations are presented from a study on neutron dosage equivalent rates. It is shown that a crew flying at altitudes near 13 km (43,000 ft) for

40 hr/mo would receive exposure levels of 47-75 Sv/yr, and it is suggested that such crewmembers be considered as radiation workers, rather than general population members. However, since present exposure estimates need to be improved, and the maximum permissible dose limits are currently under revision, the final exposure limits are, as yet, unclear, suggesting the need for further study to clarify the work status of commercial aircrews. S.A.V.

A89-29757#
ASSESSMENT OF ENERGY BALANCE IN INDIAN AIR FORCE PILOTS
SHRI A. K. SEN GUPTA, S. MUKHOPADHYAY, and D. C. GOSWAMI (Defence Research Laboratory, Tezpur, India) Defence Science Journal (ISSN 0011-748X), vol. 38, April 1988, p. 191-196. refs

The energy requirement of pilots undergoing combat training and flying supersonic aircraft is studied on the basis of energy expenditure. A study carried out on eight Indian Air Force pilots for a period of two months revealed an energy expenditure of 2668 kcal against an intake of 3846 kcal. The pilots did not show a significant change in body weight, body fat percentage, and hemoglobin level after the two months of study. K.K.

A89-30074
NEUROSIS AND HYPERTENSIVE DISEASE [NEVROZ I GIPERTONICHESKAIA BOLEZN']
V. B. ZAKHARZHEVSKII (AN SSSR, Institut Fiziologii, Leningrad, USSR) Fiziologicheskii Zhurnal SSSR (ISSN 0015-329X), vol. 74, Nov. 1988, p. 1645-1653. In Russian. refs

The relationship between neurosis and psychosomatic pathology were investigated using clinical and laboratory data as well as literature reports. Results obtained from experimental modeling of psychosomatic diseases indicate that, in a visceral system, there is a combined action of neurotization and the destabilization of regulatory mechanisms. A suppression of the vascular system's self-regulatory mechanism was detected in subjects in initial stages of hypertensive disease, in contrast to a neurosis with a hypertensive syndrome, suggesting that different mechanisms are active in the formation of a neurosis and of hypertensive disease. I.S.

A89-30088
PHASE RELATIONSHIPS OF CUPULATE AND OTOLITHIC REACTIONS AND THEIR CORRELATION WITH THE PROGRESS OF MOTION SICKNESS [FAZOVYE SOOTNOSHENIIA KUPULIARNYKH I OTOLITOVYKH REAKTSII I IKH VZAIMOSVIAZ' S RAZVITIEM UKACHIVANIIA]
O. A. VOROB'EV and A. I. PEREL'MAN Akademiia Nauk SSSR, Izvestiia, Seriia Biologicheskaia (ISSN 0002-3329), Jan.-Feb. 1989, p. 19-23. In Russian. refs

Phase relationships between the reactions of cupulate and otolithic receptors were analyzed using models of semicircular canals and otolithic organs applied to different variants of the Coriolis acceleration test as described by Markarian et al. (1966). It was found that the symptoms of motion sickness become more expressed when mismatch between the signals from cupulate and otolithic receptors is minimal. It is suggested that the main cause of motion sickness is an intrasensory mismatch between signals from visual, locomotive, and other extralabyrinth systems and the information from vestibular receptors. I.S.

A89-30143
EVALUATION OF THE FUNCTIONAL RESERVES OF THE ORGANISM DURING ADAPTATION TO DIFFERENT HEIGHTS [OTSENKA FUNKTSIONAL'NYKH VOZMOZHNOSTEI ORGANIZMA PRI ADAPTATSII K RAZLICHNYM VYSOTAM]
V. P. MAKHNOVSKII, A. S. SHANAZAROV, and E. E. VOLKOV Voenno-Meditsinskii Zhurnal (ISSN 0026-9050), Nov. 1988, p. 40-42. In Russian.

The effects of adaptation to different heights on the characteristics of the hemodynamics and the autonomic nervous system were investigated in men who resided for periods of half a year or a year and a half in regions located at 800 (control), 2800, 3600, or 3800 m. The Flack test was used to evaluate the functional status of the subjects. It was found that the year-and-a-half-long adaptation to high altitudes increased the functional reserves of the subjects, whereas the functional reserves of subjects adapted for only half a year were limited, particularly at heights of 3600 and 3800 m. I.S.

A89-30144
EFFECT OF BACKGROUND BACKBONE ANOMALIES ON THE DEVELOPMENT OF ITS INJURIES IN FLIGHT PERSONNEL UNDER ACCELERATION LOADING [VLIIANIE FONOVYKH IZMENENII POZVONOCHNIKA NA RAZVITIE EGO POVREZHDENII U LITS LETNOGO SOSTAVA PRI PEREGRUZKAKH]
R. V. POLETAEV Voenno-Meditsinskii Zhurnal (ISSN 0026-9050), Nov. 1988, p. 43-45. In Russian.

The impact of certain anomalies in the backbone on the appearance of backbone injuries caused by acceleration loading was investigated in a group of healthy pilots aged 21-45, each of whom experienced a one-time acceleration load in the head-to-pelvis direction that resulted in a fractured backbone. It was found that the subjects could be divided into four groups according to the type of background deviation present before the accident: (1) a control group, with no backbone anomalies, (2) with complicated anomalies, (3) with uncomplicated anomalies, and (4) with backbone alterations but without anomalies. The qualitative and quantitative characteristics of the backbone fractures in these subjects were found to differ substantially according to the type of background deviation. The greatest percentage (52.6 percent) of patients with fractured backbone belonged to the group with complicated anomalies, while the smallest percentage (3.57 percent) occurred in the control group. I.S.

A89-31604
INCIDENT ANALYSIS OF THE EFFECTS OF PYRIDOSTIGMINE BROMIDE
VALERIE GAWRON, JOHN BALL (Calspan Advanced Technology Center, Buffalo, NY), SAMUEL SCHIFLETT (USAF, School of Aerospace Medicine, Brooks AFB, TX), and JAMES MILLER (USAF, Flight Test Center, Edwards AFB, CA) IN: Human Factors Society, Annual Meeting, 32nd, Anaheim, CA, Oct. 24-28, 1988, Proceedings. Volume 1. Santa Monica, CA, Human Factors Society, 1988, p. 20-24.

The effects of pyridostigmine bromide, a chemical defense protective drug, on inflight aircrew performance are analyzed using the total in-flight simulation aircraft. Behaviors were grouped into categories such as irritability, humor, and accidental activation. The frequencies of each behavioral category under normal conditions and after taking pyridostigmine bromide are listed. R.B.

A89-32189
SELF-ORGANIZATION OF HEAT TRANSFER IN THE HUMAN BODY AND ITS MATHEMATICAL MODEL [SAMOORGANIZATSIIA TEPLOVOGO OBMINU ORGANIZMU TA II MATEMATICHNA MODEL']
N. G. LOZIICHUK (AN URSR, Institut Kibernetiki, Kiev, Ukrainian SSR) Akademiia Nauk Ukrains'koi RSR, Dopovidi, Seriia A - Fiziko-Matematichni ta Tekhnichni Nauki (ISSN 0002-3531), Dec. 1988, p. 58-61. In Ukrainian. refs

The paper is concerned with the development of a mathematical model describing thermal regulation processes in the human body. Temperature control of homeostasis temperature is considered as a solution to an optimal control problem of heat transfer, with allowance made for the resolution of conflict situations characteristic of the system. Results of computational experiments are discussed. V.L.

A89-32312*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
FLUID/ELECTROLYTE AND ENDOCRINE CHANGES IN SPACE FLIGHT
CAROLYN LEACH HUNTOON (NASA, Johnson Space Center,

Houston, TX) International Symposium on Aerospace Science, 2nd, Nihon University, Tokyo, Japan, Jan. 21-26, 1989, Paper. 6 p. refs

The primary effects of space flight that influence the endocrine system and fluid and electrolyte regulation are the reduction of hydrostatic gradients, reduction in use and gravitational loading of bone and muscle, and stress. Each of these sets into motion a series of responses that culminates in alteration of some homeostatic set points for the environment of space. Set point alterations are believed to include decreases in venous pressure; red blood cell mass; total body water; plasma volume; and serum sodium, chloride, potassium, and osmolality. Serum calcium and phosphate increase. Hormones such as erythropoietin, atrial natriuretic peptide, aldosterone, cortisol, antidiuretic hormone, and growth hormone are involved in the dynamic processes that bring about the new set points. The inappropriateness of microgravity set points for 1-G conditions contributes to astronaut postflight responses. Author

A89-32321* Wright State Univ., Dayton, OH.
SEROTONERGIC MECHANISMS IN EMESIS
J. B. LUCOT and G. H. CRAMPTON (Wright State University, Dayton, OH) IN: Basic and applied aspects of vestibular function. Hong Kong, Hong Kong University Press, 1988, p. 107-111. refs
(Contract NCC2-229)

The observation that the cerebrospinal fluid of cats which are susceptible to motion sickness contained lower baseline levels of 5-hydroxyindoleacetic acid, among other constituents, led to the hypothesis that serotonin inhibits emesis. The hypothesis was tested by administration of the serotonin-1A agonists buspirone and 8-OH-DPAT before motion testing in cats susceptible to motion sickness. Both drugs blocked motion sickness in a dose-dependent fashion. To determine if these drugs blocked emesis elicited by other stimuli, they were administered before subcutaneous administration of the alpha-2 noradrenergic agonist, xylazine. Both drugs also blocked xylazine-induced emesis. It was concluded that the stimulation of serotonin-1A receptors inhibits emesis elicited by the two stimuli and that this mechanism may exert a general antiemetic effect. Author

A89-32323* Beth Israel Hospital, Boston, MA.
NONLINEAR DYNAMICS, FRACTALS, CARDIAC PHYSIOLOGY AND SUDDEN DEATH
ARY L. GOLDBERGER (Beth Israel Hospital, Boston, MA) IN: Temporal disorder in human oscillatory systems. Berlin, Springer-Verlag, 1987, 9 p. Research supported by NASA. refs

The authors propose a diametrically opposite viewpoint to the generally accepted tendency of equating healthy function with order and disease with chaos. With regard to the question of sudden cardiac death and chaos, it is suggested that certain features of dynamical chaos related to fractal structure and fractal dynamics may be important organizing principles in normal physiology and that certain pathologies, including ventricular fibrillation, represent a class of 'pathological periodicities'. Some laboratory work bearing on the relation of nonlinear analysis to physiological and pathophysiological data is briefly reviewed, with tentative theories and models described in reference to the mechanism of ventricular fibrillation. S.A.V.

A89-32340
THRESHOLDS FOR THE PERCEPTION OF WHOLE BODY ANGULAR MOVEMENT ABOUT A VERTICAL AXIS
A. J. BENSON, E. C. B. HUTT, and S. F. BROWN (RAF, Institute of Aviation Medicine, Farnborough, England) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 60, March 1989, p. 205-213. refs

Thresholds for the detection (at $p = 0.75$ correct) of the direction of discrete angular movements about a vertical Z axis, having a cosine bell velocity trajectory and a duration of 3.3 sec, were determined using an adaptive psychophysical procedure. In 30 subjects, the mean threshold for the detection of Z axis stimuli was 1.5 deg/sec. X and Y axis thresholds of 20 subjects had mean values of 2.04 and 2.07 deg/sec, respectively, and were significantly higher than Z axis thresholds. The mean Z axis threshold of six subjects, who viewed a visual target fixed to the turntable, was reduced by 8.6 dB over that obtained in darkness. Z axis thresholds were found to increase at 5.9 dB/decade as a function of stimulus duration over the range 0.9 to 20 sec. The possible implication of this finding in relation to the dynamics of the sensory system mediating the perception of whole-body angular movement is discussed. Author

A89-32341* Louisiana State Univ., Shreveport.
ELECTROGASTROGRAMS DURING MOTION SICKNESS IN FASTED AND FED SUBJECTS
JOHN J. STEWART, MARY J. WOOD, and CHARLES D. WOOD (Louisiana State University, Shreveport) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 60, March 1989, p. 214-217. refs
(Contract NAG9-167)

Seven human volunteers were subjected to stressful Coriolis stimulation (rotating chair) either during the fasted state or following the ingestion of yogurt (6 oz). Subjects tested after yogurt reached a malaise-III (M-III) endpoint of motion sickness after significantly (p smaller than 0.01) fewer head movements than subjects tested in the fasted state. Surface electrogastrogram (EGG) recordings at M-III were similar for both dietary stats and consisted of a brief period of tachygastria, followed by a period of low-amplitude EGG waves. Ingestion of yogurt enhanced susceptibility to motion sickness but did not affect the associated pattern of EGG. Author

A89-32346
LIMITATIONS OF POSTURAL EQUILIBRIUM TESTS FOR EXAMINING SIMULATOR SICKNESS
KEVIN M. HAMILTON, LIDA KANTOR, and LOCHLAN E. MAGEE (DND, Defence and Civil Institute of Environmental Medicine, Downsview, Canada) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 60, March 1989, p. 246-251. refs

The psychometric properties of four ataxia tests and their sensitivities to disorientation were examined to assess their potential for measuring balance disturbances frequently reported with simulator sickness. The study was conducted in two parts. In the first, subjects practiced for 10 sessions to examine learning effects and to stabilize performance. In the second, the sensitivities of the four tests were examined by comparing performance before and after exposure to sensory conflict produced using a disorientation training flight simulator. Subjective measures of disorientation, including reports of postural disequilibrium, were also collected. The results indicated initial learning on all four ataxia measures. Two of the tests, the Stand on One Leg Eyes Closed and the the Sharpened Romberg, exhibited acceptable levels of reliability. However, only the latter showed sufficient sensitivity to corroborate subjective reports of postural disequilibrium. Author

A89-32347
SIMULATOR INDUCED SYNDROME - EVIDENCE FOR LONG-TERM AFTEREFFECTS
TIMOTHY J. UNGS (USCG, Kodiak, AK; Wright State University, Dayton, OH) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 60, March 1989, p. 252-255. refs

This study surveyed pilots undergoing simulator training in an attempt to provide an initial gauge of the extent, severity, and possible risk factors of long-term (longer than 1 day) simulator aftereffects. A three-part voluntary and anonymous questionnaire was used to gather data. Pilots of varying experience were studied, who were undergoing advanced flight training which included the use of flight simulators. Some 238 pilots participated in the study, and 196 completed the followup survey concerning long-term effects. Nine (4.6 percent) pilots experienced adverse symptoms 24 h or more after completion of their last simulator training, which they attributed to their recent simulator experience. Symptoms reported included recurrent visual flashbacks, continued balance disturbance, and hand-eye discoordination. Three pilots (1.5 percent) reported difficulties flying aircraft. Pilot flight experience

level, total simulator time, the length of simulator session, and sex were not predictive of risk. Author

A89-32348
TYPE II ALTITUDE DECOMPRESSION SICKNESS (DCS) - U.S. AIR FORCE EXPERIENCE WITH 133 CASES
SALIMI A. WIRJOSEMITO, JOHN E. TOUHEY, and WILBUR T. WORKMAN (USAF, School of Aerospace Medicine, Brooks AFB, TX) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 60, March 1989, p. 256-262. refs

Case histories of 133 cases of Type II altitude-related decompression sickness (DCS) among the U.S. Air Force pilots were reviewed. The most common manifestation observed after the altitude chamber training was joint pain (43.6 percent) and joint pain associated with headache (42.1 percent), visual disturbances (30.1 percent), or/and limb paresthesia (27.8 percent). Other symptoms included (in order of decreasing frequency) mental confusion (24.8 percent), limb numbness (16.5 percent), and extreme fatigue (10.5 percent). Spinal cord involvement, chokes, and unconsciousness were rare (6.9, 6.0, and 1.5 percent, respectively). Hyperbaric oxygen treatment was reported to alleviate all symptoms in 97.7 percent of the cases. I.S.

A89-32349
EVALUATION OF THE SLEEPY CREWMEMBER - USAFSAM EXPERIENCE AND A SUGGESTED CLINICAL APPROACH
MARC KATCHEN and GARY S. GRONSETH (USAF, School of Aerospace Medicine, Brooks AFB, TX) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 60, March 1989, p. 263-267. refs

From 1958 to 1986, 27 crewmembers with suspected sleep disorders were referred to the USAF School of Aerospace Medicine. The presenting complaint in most cases was excessive daytime sleepines (EDS). Prior to 1984, evaluations included neurologic and psychiatric testing, screening laboratory studies, and awake and asleep electroencephalography. Polysomnography and sleep latency studies were included after 1984. In the majority of cases, the etiology of the complaint could not be determined. The prevalence of EDS is estimated to be between 0.3 and 4.0 percent of the adult population. Major causes cited in the world literature include the sleep apnea syndromes, narcolepsy, parasomnias interrupting sleep, hypersomnia secondary to systemic or affective disorders, and essential hypersomnia. Current sleep lab techniques and human leukocyte antigen typing are reported to make the diagnosis in up to 90 percent of sleep disorders. Evaluation of EDS should begin with a history emphasizing sleep habits, work schedules, daytime naps, and presence of vegetative signs. A sleep diary will allow a more accurate estimate of the quantity of nocturnal sleep. This diary may reveal poor sleep hygiene or insomnia. Polysomnography and/or multiple sleep latency determination can then be used to diagnose sleep apnea, parasomnias, and narcolepsy. Author

A89-32350
AIRCRAFT NOISE-INDUCED TEMPORARY THRESHOLD SHIFT
YONG-XIANG WU, XIAO-LIN LIU, BING-GUANG WANG, and XIN-YU WANG (Air Force PR China, Institute of Aviation Medicine, Beijing, People's Republic of China) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 60, March 1989, p. 268-270. refs

Audiograms were taken on 20 young men before and immediately after exposure to Fighter-6 ground running-up noise, and their course of recovery was followed. The sound levels at the engine hatch were 117-128 dB(A). The noise-induced temporary threshold shift was more than 13 dB. The maximum threshold shift occurred at 4 kHz. The shift in the low and speech frequencies recovers more rapidly and is completed in 30 min, whereas that in high-frequency range recovers much more slowyly, not returning to normal until 24 h later. High-frequency hearing loss is at risk in groundcrew. In order to prevent hearing damage, they ought to wear ear-protectors. It was discovered that the V-shaped depression was not at 4 kHz but at 6 kHz. The former view concerning the pathogenesis of the '4 kHz depression', therefore, is open to question. Author

N89-19108# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Cologne (Germany, F.R.). Inst. fuer Flugmedizin.
HUMAN PHYSIOLOGICAL ADAPTATION TO MICROGRAVITY IN SPACE [PHYSIOLOGISCHE ANPASSUNG DES MENSCHEN AN DIE MIKROGRAVITATION DES WELTRAUMS]
K. E. KLEIN *In its* Second Summer School on Microgravity. 2: Life Sciences as Main Subject p 63-72 Jun. 1988 In GERMAN
Avail: NTIS HC A09/MF A01

Physiological reactions as response to environmental problems of man in space are described. Anthropometry and human body mass are modified in weightlessness. Blood composition, immunology, and senso-motricity are examined in terms of space adaptation syndrome. Muscles and skeleton system during inflight and postflight days are surveyed. ESA

N89-19109# Technische Univ., Munich (Germany, F.R.). Medizinische Klinik Inst.
PHARMACOKINETICS [PHARMAKOKINETIK]
R. GERZER *In* DFVLR, Second Summer School on Microgravity. 2: Life Sciences as Main Subject p 75-80 Jun. 1988 In GERMAN
Avail: NTIS HC A09/MF A01

Space flight related pharmacokinetics and drug effectiveness associated with toxicological effects are examined. LADME principles in pharmacokinetics are outlined by a three step mechanism: drug liberation, absorption and distribution in the body. Receptors coupled processes designed as second messengers are presented. ESA

N89-19110# Stuttgart Univ. (Germany, F.R.). Inst. fuer Zoologie.
NEURON ADAPTABILITY [NEURONALE ANPASSUNGSFAEHIGKEIT]
H. RAHMANN and K. SLENZKA *In* DFVLR, Second Summer School on Microgravity. 2: Life Sciences as Main Subject p 81-89 Jun. 1988 In GERMAN
Avail: NTIS HC A09/MF A01

Biochemical and physiochemical parameters for functional adaptability of synapses are analyzed. Brain and central nervous system involved in adaptability processes are examined. Physical factors like light or temperature are investigated for their effects on neuron plasticity in central nervous system. ESA

N89-19114# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Cologne (Germany, F.R.). Inst. for Aerospace Medicine.
RADIATION PROTECTION PROBLEMS IN SPACE
G. REITZ and H. BUECKER *In its* Second Summer School on Microgravity. 2: Life Sciences as Main Subject p 133-150 Jun. 1988
Avail: NTIS HC A09/MF A01

Effective radiation protection is discussed and the modification of the radiobiological consequences of a given exposure by microgravity is investigated. Radiation protection levels, measurement of doses, and calculation of dose equivalent limits are examined. ESA

N89-19119# Texas A&M Univ., College Station. Bioengineering Program.
TEMPERATURE MEASUREMENT AND MONITORING DEVICES Final Report, Jul. 1987 - May 1988
CHARLES S. LESSARD, WING C. WONG, and GLENN F. SCHMIDT Aug. 1988 · 24 p
(Contract F33615-86-C-2733)
(AD-A201643; HSD-TR-88-011) Avail: NTIS HC A03/MF A01
CSCL 14B

The principal aim of this study was to evaluate current literature on noninvasive methods and instruments on core temperature

(body's temperature in deep tissue, i.e., heart). A specific goal is a conceptual design for a device to measure core temperature through chemical defense clothing. This report reviews temperature sensing devices, infrared thermography and emphasizes microwave thermography. GRA

N89-19120* National Aeronautics and Space Administration, Washington, DC.
AEROSPACE MEDICINE AND BIOLOGY: A CUMULATIVE INDEX TO A CONTINUING BIBLIOGRAPHY (SUPPLEMENT 319)
Jan. 1989 243 p
(NASA-SP-7011(319); NAS 1.21:7011(319)) Avail: NTIS HC A11; NTIS standing order as PB89-912300, $10.50 domestic, $21.00 foreign CSCL 06E

This publication is a cumulative index to the abstracts contained in Supplements 307 through 318 of Aerospace Medicine and Biology: A Continuing Bibliography. Seven indexes are included -- subject, personal author, corporate source, foreign technology, contract number, report number and accession number. Author

N89-19121* National Aeronautics and Space Administration, Washington, DC.
AEROSPACE MEDICINE AND BIOLOGY: A CONTINUING BIBLIOGRAPHY WITH INDEXES (SUPPLEMENT 320)
Feb. 1989 50 p
(NASA-SP-7011(320); NAS 1.21:7011(320)) Avail: NTIS HC A03; NTIS standing order as PB89-912300, $10.50 domestic, $21.00 foreign CSCL 06E

This bibliography lists 125 reports, articles and other documents introduced into the NASA Scientific and Technical Information System during January, 1989. Subject coverage includes: aerospace medicine and psychology, life support systems and controlled environments, safety equipment, exobiology and extraterrestrial life, and flight crew behavior and performance. Author

N89-19796# Krug International, San Antonio, TX. Technology Services Div.
AN ANNOTATED BIBLIOGRAPHY OF HYPOBARIC DECOMPRESSION SICKNESS RESEARCH CONDUCTED AT THE CREW TECHNOLOGY DIVISION, USAF SCHOOL OF AEROSPACE MEDICINE, BROOKS AFB, TEXAS FROM 1983 TO 1988 Interim Report, 1 Jun. 1983 - 15 Oct. 1988
JAMES T. WEBB, ROBERT W. KRUTZ, JR., and GENE A. DIXON Oct. 1988 24 p
(Contract F33615-85-C-4503)
(AD-A201274; USAFSAM-TP-88-10) Avail: NTIS HC A03/MF A01 CSCL 06J

Four major protocols, one of which includes five studies, have been initiated or completed in the 5-year period from 1983 to 1988. The studies have resulted in numerous publications which are listed as the references for this review. The purpose of this review is to provide an accessible summary of these extensive efforts and document the history of their accomplishments. The cross-reference information contained in this review is intended to simplify data accession within both published and data base records. A listing of the abbreviated title, protocol approval information, sponsorship information, computer database (HYPOB) retrieval numbers/titles, dates of exposure, and information about subjects, prebreathe, and exposure parameters for each study is followed by the published abstracts from each publication. GRA

N89-19797# Navy Personnel Research and Development Center, San Diego, CA.
BRAIN ACTIVITY DURING TACTICAL DECISION-MAKING. PART 4: EVENT-RELATED POTENTIALS AS INDICES OF SELECTIVE ATTENTION AND COGNITIVE WORKLOAD
LEONARD J. TREJO, GREGORY W. LEWIS, and MARK H. BLANKENSHIP Oct. 1988 24 p
(AD-A201370; NPRDC-TN-89-6) Avail: NTIS HC A03/MF A01 CSCL 05H

The demands of modern combat systems have the potential for exceeding the capacity of the human to accurately process information, especially during times of great stress. The capacity of the human to perceive, integrate, remember, and use information may be challenged when the individual is flying aircraft, monitoring radar and sonar displays, or operating electronic warfare systems. Exceeding the capacity of the human operator in such situations may impair decision-making and could result in costly tactical errors. Although much is being done to improve the reliability of combat systems, not enough is being done to improve the system operators. For these reasons, the most unpredictable element in combat systems is the human operator. Years of personnel testing have not eliminated this unpredictability. In part, this is because traditional testing methods tend to measure that a person knows rather than how a person thinks and processes information. This research is driven by the Navy's need for better methods of assessing combat system operators, particularly for predicting the ability of operators to continue to make accurate decisions under heavy workloads. This report, the fourth in a series of reports concerned with the use of neuroelectric signals to predict the decision-making performance of combat system operators, provides detailed analyses of the neuroelectric changes that occur as workload increases in a combat system simulation. GRA

N89-19798# Air Force Inst. of Tech., Wright-Patterson AFB, OH.
A STUDY TO ANALYZE THE DEGREE OF THE RELATIONSHIP BETWEEN HEALTH PRACTICES AND FATIGUE M.S. Thesis
SHERRY L. KENNEDY Sep. 1988 131 p
(AD-A201518; AFIT/GSM/LS/88S-12) Avail: NTIS HC A07/MF A01 CSCL 05I

The intention of this research was to examine the health practices of higher ranked individuals, both military and civilian, at Aeronautical Systems Division to determine if a relationship exists between the health practices they are following and the amount of fatigue they are experiencing. The health practices studied were: alcohol consumption, caffeine consumption, amount of exercise, eating habits, sleeping habits, smoking habits, and psychological stress management. These seven health practices were analyzed and compared to the amount of fatigue being experienced for both psychological and physiological fatigue. The level of fatigue was determined by individual responses to subjective self-analysis questions. Comparisons were also made between military and civilian personnel to determine if significant differences existed in health practices or in levels of fatigue. GRA

N89-19799# Army Research Inst. of Environmental Medicine, Natick, MA.
DEXAMETHASONE FOR PREVENTION AND TREATMENT OF ACUTE MOUNTAIN SICKNESS
PETER H. HACKETT, ROBERT C. ROACH, ROBERT A. WOOD, RICHARD G. FOUTCH, RICHARD MEEHAN, DRUMMOND RENNIE, and WILLIAM J. MILLS, JR. 3 Mar. 1988 17 p Submitted for publication
(AD-A201554; USARIEM-M39-88) Avail: NTIS HC A03/MF A01 CSCL 06J

Acute mountain sickness (AMS) is a common malady afflicting persons ascending quickly to high altitude. Although generally not life-threatening and usually self-limiting, AMS is often incapacitating. Potentially fatal pulmonary and cerebral edema may develop in as many as five to ten percent of those with AMS. Staged ascent with adequate time for acclimatization is optimal for prevention, but is not always effective and is often impractical. Therefore, pharmacological prophylaxis has been of great interest. The current agent of choice for prevention of AMS is acetazolamide. One field study found dexamethasone also effective in preventing symptoms of AMS. The investigators gave 4mg dexamethasone every six hours starting 48 hours prior to decompression or ascent. The subjects were sedentary. We also wished to study dexamethasone as a treatment for established cases of AMS. We rapidly transported fifteen soldiers from sea level to 4400m. The study included a double-blind, placebo-controlled trial of 2mg dexamethasone every six hours starting 1 hour before flight to

high altitude; and subsequently a trial of 4mg dexamethasone every six hours for the treatment of AMS. We found that the lower dose dexamethasone did not prevent AMS in active soldiers, and that the higher dose of dexamethasone was an effective treatment for those ill with AMS. GRA

N89-19800# Army Research Inst. of Environmental Medicine, Natick, MA.
SATELLITE REMOTE SENSING OF HEAT STRESS DURING RESERVE TRAINING AT FORT HOOD
W. MATTHEW, G. THOMAS, M. ROSE, R. HUBBARD, R. WHANG, F. SCHATZLE, J. BALDWIN, S. HSU, O. HUH, and F. QUIRK 17 Oct. 1988 9 p Presented at the 9th Annual EOSAEL/TWI Conference, Las Cruces, NM, 29 Nov. - 1 Dec. 1988
(AD-A201555; USARIEM-M2-89) Avail: NTIS HC A02/MF A01 CSCL 04B

Weather effects on soldiers have a profound impact on military operations in climatic extremes. In hot regions, soldier performance limits and drinking water requirements are crucial factors in mission planning and tactical options. The ability to quantify heat stress levels across an entire operational area would provide an information resource for optimizing soldier performance in high mobility Airland scenarios. Preliminary tests of satellite remote sensing methods currently under development (SBIR contract No. DAMD 17-86-C-6004), were conducted during reserve training operations at Fort Hood, Texas in June 1988. Data were obtained from the AVHRR (Advanced Very High Resolution Radiometer) and TOVS (TIROS Operational Vertical Sounder) instruments aboard NOAA polar orbiting satellites. WBGT (Wet Bulb Globe Temperature) index values derived from satellite data are compared with contemporary surface level measurements and heat casualty rates. Results and salient issues in further development of this capability are described. GRA

N89-19801# Delaware Univ., Newark.
BRAIN MECHANISMS UNDERLYING INDIVIDUAL DIFFERENCES IN REACTION TO STRESS: AN ANIMAL MODEL Final Report, 1 May 1985 - 31 Aug. 1988
JEROME SIEGEL, PATRICIA M. SAXTON, and DAVID F. SISSON 29 Oct. 1988 14 p
(Contract DAAG29-85-K-0085)
(AD-A201595; ARO-21733.4-LS) Avail: NTIS HC A03/MF A01 CSCL 06D

The research described in this final report is designed to expand the animal model for augmenting-reducing in rats and cats. Much effort has been put into developing an acute preparation in which VEPs variability is maintained at a manageable level. A two pronged effort is used to determine the neural mechanisms underlying augmenting-reducing. First, laminar origins of the components of VEPs. With this information, anatomical and physiological knowledge of visual cortex can be used to narrow down the putative mediators for this phenomenon. Second, determination of the effect of electrical and chemical lesions and electrical stimulation of subcortical nuclei on VEPs can be used to attempt to experimentally control the mechanisms that produce augmenting-reducing. GRA

N89-19802# Massachusetts Inst. of Tech., Cambridge. Center for Biological Information Processing.
COMPUTATION OF STEREO AND VISUAL MOTION: FROM BIOPHYSICS TO PSYCHOPHYSICS Progress Report, 1 Apr. - 30 Sep. 1988
TOMASO POGGIO, ELLEN HILDRETH, NORBERTO GRZYWACZ, and HEINRICH BUELTHOFF 30 Sep. 1988 8 p
(Contract N00014-85-C-0038)
(AD-A201873) Avail: NTIS HC A02/MF A01 CSCL 09A

During the second and third quarter of this stretchout year of funding, we have continued to explore a number of problems in motion analysis, including the parallel detection of motion using a correlation-based mechanism, motion correspondence, neural mechanisms for motion detection and measurement, and the recovery of 3-D structure and motion. We are also starting to focus more deeply on the integration of multiple visual cues. Described here is some work on the interaction between surface shape, albedo, and the illuminant direction. As we noted in our previous report, we are developing and testing some variations on a parallel network model recently proposed by Hutchinson, Koch, Luo and Mead for combining the computation of the smoothest velocity field with line processes (suggested by Geman and Geman) for handling motion discontinuities. Our modified network derives the initial motion measurements only at the locations of significant intensity changes, allows greater flexibility in the placement of the discontinuities and considers variations on the energy function being minimized to implement the smoothness constraint. The network is also designed in a way that more closely parallels physiological properties of motion-sensitive neurons in area MT of monkey visual cortex. GRA

N89-19803# Wright State Univ., Dayton, OH.
A STRESS TEST TO EVALUATE THE PHYSICAL CAPACITY OF PERFORMING L-1 ANTI-G STRAINING MANEUVERS Final Technical Report, Aug. 1987 - Aug. 1988
WEN-YAW CHIOU Sep. 1988 38 p
(AD-A202301; AAMRL-TR-88-047) Avail: NTIS HC A03/MF A01 CSCL 06J

To evaluate the physical capacity of performing L-1 anti-G straining maneuvers (AGSM), 9 subjects participated in stress test protocols which were designed to use repetitive AGSM exercise on the ground. Physiological responses of oxygen uptake (VO2), minute pulmonary ventilation (VE), respiratory exchange ratio (RER) and heart rate (HR) were determined for steady state exercises at AGSM duty cycles of 20, 25, 33, and 50 percent. The individual's physical capacity for performing AGSM can be objectively evaluated by the strength (peak output) and endurance (time to 40 percent fatigue) aspects of this continuous stress test. The higher peak VO achieved, the greater was considered the aerobic energy output for AGSM performance. This is dependent upon the muscle mass available, the condition of the muscles, as well as cardiopulmonary fitness of the individual. The longer endurance time for the ground test, the longer tolerance duration will most likely be obtained during actual centrifuge G-force testing. Therefore, the described AGSM stress test on the ground may be a convenient, inexpensive and useful tool to objectively evaluate the physical capacity of individuals for performing AGSM. Such a test may be used for pilot candidate screening prior to centrifuge and aircraft G-tolerance testing. GRA

N89-19804# Technische Univ., Eindhoven (Netherlands).
ULTRASOUND TRANSMISSION TOMOGRAPHY, A LOW-COST REALIZATION Ph.D. Thesis
GERRIT SOLLIE 1988 172 p
(ISBN-90-9002330-5; ETN-89-93894) Avail: NTIS HC A08/MF A01

A prototype transmission tomography system was developed and tested. Images can be obtained of the distributions of three independent physical quantities in a cross-section of the measured object: the local sound propagation velocity, the local attenuation coefficient, and the local derivative with respect to frequency of the attenuation coefficient. The images of these quantities are reconstructed from three sets of values that are measured simultaneously from one reverberating sound pulse. The measuring values, which are the time-of-flight, the amplitude, and the center frequency of the pulse, are obtained from this reverberating pulse without knowing the exact RF-signal. This eliminates the need of a very expensive, high-frequency sampling device. The tomography system offers the possibility of performing a limited degree of tissue characterization because of the specific combinations of the three physical quantities for different biological tissues. ESA

N89-20067*# Alma Coll., MI. Dept. of Exercise and Health Science.
A MODEL FOR PLASMA VOLUME CHANGES DURING SHORT DURATION SPACEFLIGHT Final Report
JOHN E. DAVIS *In* NASA, Lyndon B. Johnson Space Center, National Aeronautics and Space Administration (NASA)/American

Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1988, Volume 1 15 p Feb. 1989
Avail: NTIS HC A09/MF A01 CSCL 06P

It is well established that plasma volume decreases during spaceflight and simulated weightlessness (bedrest). The decrement in plasma volume is thought to contribute to the orthostatic intolerance that has been observed in some crew members following spaceflight. To date, no studies have evaluated the effectiveness of fluid countermeasures of varying osmolality in the restoration of plasma volume and orthostatic tolerance in a controlled study. The overall objectives of this project were to: (1) provide a model that would rapidly and safely produce a fluid loss comparable to that which occurs during short duration spaceflight; and (2) design a study that would determine the optimal drink solution to restore orthostatic tolerance and describe the mechanism(s) whereby orthostatic tolerance is restored. In summary, Lasix can be used as a way of simulating the plasma volume changes that occur during short duration spaceflight. The total loss of plasma is comparable to spaceflight. Lasix is fast acting, and has relatively few side effects. The present design for evaluating the optimal fluid countermeasures will have important implications in restoring orthostatic tolerance and function in the latter stages of spaceflight when it is essential for safe operation of the spacecraft. Author

N89-20069*# University of Central Washington, Ellensburg. Dept. of Physical Education.
EFFECTS ON MOTOR UNIT POTENTIATION AND GROUND REACTION FORCE FROM TREADMILL EXERCISE Final Report
REID P. ELAM *In* NASA, Lyndon B. Johnson Space Center, National Aeronautics and Space Administration (NASA)/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1988, Volume 1 13 p Feb. 1989
Avail: NTIS HC A09/MF A01 CSCL 06S

This study was conducted to analyze the characteristics of motor unit potentiation (MUP) and ground reaction force (GRF) in treadmill exercise at the inclines of 0, 5.5 and 11 percent with conjuctive speeds of 7.5, 6, and 5 mph respectively. These speeds and corresponding inclines were set to provide equivalent physiological workloads at 12.5 METS. EMG recordings were taken from the rectus femoris and gastrocnemius of the right leg from 5 subjects. Simultaneous GRF recordings were obtained from a Delmar Avionic treadmill rigged with load cells. Measures for MUP and GRF were taken over a period containing 10 strides at steady pace. It was concluded that the gastrocnemius was more evident in EMG activity in all speed/incline settings over the rectus femoris, and that inclines from 5.5 to 11 percent produced greater GRF's over 0 percent. Recommendations for future studies was made. Author

N89-20076*# Texas Univ., Galveston. Dept. of Pharmacology and Toxicology.
MALADJUSTMENT OF KIDNEYS TO MICROGRAVITY: DESIGN OF MEASURES TO REDUCE THE LOSS OF CALCIUM Final Report
BOHDAN R. NECHAY *In* NASA, Lyndon B. Johnson Space Center, National Aeronautics and Space Administration (NASA)/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1988, Volume 2 14 p Feb. 1989
Avail: NTIS HC A09/MF A01 CSCL 06P

Losses of skeletal calcium and body fluids occur during prolonged exposure to microgravity. The kidney plays a major role in regulating the physiological functions involved. Relative to this regulatory function, the kidney performs three operations: filtration of blood plasma through the glomeruli, reabsorption, and secretion of fluid and electrolytes so that needed components are retained and only waste is eliminated in the urine. Using data published in Biomedical Results from Skylab, researchers performed new calculations that reflect more directly the operations of the kidney in the handling of calcium, sodium, chloride, potassium and phosphate during space flight. These calculations revealed that the fraction of filtered calcium that was rejected by renal tubules and excreted in the urine increased by 71 percent, from 1.77 percent (preflight) to 3.02 percent (inflight) of the filtered load. This represents a large absolute increase because the total filtered amount is huge. Because the tubular rejection fraction of other ions increased relatively less than that of calcium, researchers postulate the inflight development of a specific renal defect that causes an excessive loss of calcium in urine and thereby contributes to the weakening of bones. Author

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BEHAVIORAL SCIENCES

Includes psychological factors; individual and group behavior; crew training and evaluation; and psychiatric research.

A89-29314* California State Univ., Hayward.
JUDGMENTS OF EYE LEVEL IN LIGHT AND IN DARKNESS
ARNOLD E. STOPER (California State University, Hayward) and MALCOLM M. COHEN (NASA, Ames Research Center, Moffett Field, CA) Perception and Psychophysics (ISSN 0031-5117), vol. 40, no. 5, 1986, p. 311-316. refs

Subjects judged eye level in the light and in the dark by raising and lowering themselves in a dental chair until a stationary target appeared to be at the level of their eyes. This method reduced the possibility of subjects' using visible landmarks as reference points for setting eye level during lighted trials, which may have contributed to artificially low estimates of the variability of this judgment in previous studies. Chair settings were 2.5 deg higher in the dark than in the light, and variability was approximately 66 percent greater in the dark than in the light. These results are discussed in terms of possible interactions of two separate systems, one sensitive to the orientations of visible surfaces and the other sensitive to bodily and gravitational information. Author

A89-29735
JOB-SPECIFIC INTERNAL PERFORMANCE REQUIREMENTS OF AIRCRAFT PILOTS [BERUFSSPEZIFISCHE INNERE LEISTUNGSVORAUSSETZUNGEN DES FLUGZEUGFUEHRERS]
KARIN MUELLER and EVELYN SCHULZE (Medizinischer Dienst des Verkehrswesens der DDR, Berlin, German Democratic Republic) Technisch-oekonomische Information der zivilen Luftfahrt (ISSN 0232-5012), vol. 24, no. 6, 1988, p. 204-207. In German. refs

The psychological aspect of aircraft pilot performance is discussed. A model is developed for the particular psychological requirements of different pilot tasks. Some practical consequences of the model are examined. C.D.

A89-29736
FLIGHT PHOBIA AND ITS SIGNIFICANCE FOR JUDGING THE FITNESS OF FLIGHT CREWS IN CIVIL AVIATION [DIE FLUGPHOBIE UND IHRE BEDEUTUNG FUER DIE BEURTEILUNG DER TAUGLICHKEIT DES FLIEGENDEN PERSONALS DER ZIVILLUFTFAHRT]
BODO SCHMOCK (Medizinischer Dienst des Verkehrswesens der DDR, Berlin, German Democratic Republic) Technisch-oekonomische Information der zivilen Luftfahrt (ISSN 0232-5012), vol. 24, no. 6, 1988, p. 209, 210. In German. refs

A89-30142
CORRECTING THE ORGANISM'S FUNCTIONAL STATE IN AVIATION SCHOOL FLIGHT INSTRUCTORS DURING THE PERIOD OF INTENSIVE FLIGHTS [KORREKTSIIA FUNKTSIONAL'NOGO SOSTOIANIIA ORGANIZMA LETCHIKOV-INSTRUKTOROV AVIATSIONNYKH UCHILISHCH V PERIOD INTENSIVNYKH POLETOV]
V. I. KOPANEV and V. A. EGOROV Voenno-Meditsinskii Zhurnal (ISSN 0026-9050), Oct. 1988, p. 54-56. In Russian. refs

The adverse effect of high emotional stress in flight instructors, which was aggravated during the period of intensive flights (from April to August) in aviation schools, on the instructors' work capacity and functional status is discussed together with the corrective measures that can be taken to ameliorate this effect. The efficiencies of three of these corrective methods, namely, the self-massage of specific acupuncture points (APs), a complex of physical exercises, and the electroanalgesia of the central nervous system, in relieving specific symptoms of emotional and physical stress are compared. It was found that the massage of APs is particularly effective in ameliorating the symptoms of fatigue. I.S.

A89-31436
THE PERCEPTION OF MOVING PLAIDS REVEALS TWO MOTION-PROCESSING STAGES
LESLIE WELCH (Smith-Kettlewell Eye Research Institute, San Francisco; California, University, Berkeley) Nature (ISSN 0028-0836), vol. 337, Feb. 23, 1989, p. 734-736. Research supported by USAF and NIH.

Two models of the perceived motion of a long moving line or grating are examined. One model resolves the ambiguity of the motion by monitoring the motion of a distinctive feature, such as a line-end or corner. The other model (Adelson and Movshon, 1982) suggests that moving images are processed in two stages: decomposition into one-dimensional components and recombination to generate perceived object motion. Using speed discrimination, it is shown that discrimination thresholds reflect the speed of a plaid's component gratings, rather than the speed of the plaid itself. The results suggest that the two-stage model is correct. R.B.

A89-31602
THE EFFECTS OF NESTED TEXTURE ON A LANDING-JUDGMENT TASK
KIMBERLY A. REARDON (Systems Research Laboratories, Inc., Dayton, OH) IN: Human Factors Society, Annual Meeting, 32nd, Anaheim, CA, Oct. 24-28, 1988, Proceedings. Volume 1. Santa Monica, CA, Human Factors Society, 1988, p. 10-14. refs

The effects of nested texture was studied with four types of displays in a landing-judgment task. Subjects viewed a simulating landing approach to a runway on four types of displays, each having a different texture. The simulation froze after 20 sec and the viewers were asked to indicate where they would land if they continued on the same course. When texture was nested as a function of altitude, performance was the same as when texture was constant throughout the trial. Subjects perceived their aimpoint further down the runway as the complexity of the texture increased. R.B.

A89-31603
THE ACTIVE CONTROL OF ALTITUDE OVER DIFFERING TEXTURE
LAWRENCE WOLPERT (Systems Research Laboratories, Inc., Dayton, OH) IN: Human Factors Society, Annual Meeting, 32nd, Anaheim, CA, Oct. 24-28, 1988, Proceedings. Volume 1. Santa Monica, CA, Human Factors Society, 1988, p. 15-19. refs

Earlier passive judgment studies showed that detection of loss in altitude was more accurate over texture consisting of stripes parallel to the direction of flight, than over texture consisting of perpendicular stripes or a combination of both, i.e., a square pattern. The current experiment required the participants to actively control and maintain a constant altitude over similar texture in the presence of a pseudorandom windgust. Results corresponded to those of the earlier judgment study with altitude being better controlled when flight took place over parallel texture, than over perpendicular or square texture. Theoretical and applied implications of these findings are discussed. Author

A89-31615
PERCEPTION OF REAL AND SIMULATED MOTION IN THE AUDITORY MODALITY
THOMAS Z. STRYBEL (California State University, Long Beach) IN: Human Factors Society, Annual Meeting, 32nd, Anaheim, CA, Oct. 24-28, 1988, Proceedings. Volume 1. Santa Monica, CA, Human Factors Society, 1988, p. 76-80. refs

Future head-coupled display systems will include auditory spatial information in order to direct the pilot's attention to critical events in the environment. It is anticipated that such a system will provide dynamic as well as static auditory location information. This report reviews current research in the area of auditory motion perception, particularly as it applies to the development of simulated three-dimensional auditory space. Author

A89-31619
A THEORY OF SITUATION ASSESSMENT - IMPLICATIONS FOR MEASURING SITUATION AWARENESS
MARTIN L. FRACKER (USAF, Aerospace Medical Research Laboratory, Wright-Patterson AFB, OH) IN: Human Factors Society, Annual Meeting, 32nd, Anaheim, CA, Oct. 24-28, 1988, Proceedings. Volume 1. Santa Monica, CA, Human Factors Society, 1988, p. 102-106. refs

A theory of situation awareness which includes a definition of situation awareness and a model of situation assessment is presented. Previous definitions of situation awareness are reviewed. The operation of the model of situation assessment is discussed, emphasizing cognitive biases that result from the knowledge matching process. Also, implications of the model for measuring situation awareness are considered. R.B.

A89-31620
INFORMATION TRANSFER FROM INTELLIGENT EW DISPLAYS
MARION P. KIBBE (U.S. Navy, Naval Weapons Center, China Lake, CA) IN: Human Factors Society, Annual Meeting, 32nd, Anaheim, CA, Oct. 24-28, 1988, Proceedings. Volume 1. Santa Monica, CA, Human Factors Society, 1988, p. 107-110.

Dual-task performance and recalled information data were used to compare levels of situational awareness from manual and automated threat recognition tasks. Dual-task performance reflected the effects of monitoring an automated system while tracking. There were no differences in information transfer as a function of automation. Author

A89-31622
COMPARING OCULOMETER AND HEAD-FIXED RETICLE WITH VOICE OR SWITCH FOR TACTICAL DISPLAY INTERACTION
CHRISTOPHER C. SMYTH and MARY E. DOMINESSY (U.S. Army, Human Engineering Laboratory, Aberdeen Proving Ground, MD) IN: Human Factors Society, Annual Meeting, 32nd, Anaheim, CA, Oct. 24-28, 1988, Proceedings. Volume 1. Santa Monica, CA, Human Factors Society, 1988, p. 116-120.

An oculometer with switch or voice, a head-fixed reticle with switch or voice, and a touch panel are compared, emphasizing their performance as data entry methods on a generic tactical air combat display. Tests with 15 subjects show significant differences in performance for the five configurations at the .0001 level. It is shown that the reticle/switch, oculometer/switch, and touch panel are significantly faster than the reticle/voice configuration. The oculometer/voice configuration is the slowest of those tested. The touch panel is twice as accurate as the other methods, while the oculometer/voice has nearly twice as many selection errors as the other methods. R.B.

A89-31625* Illinois Univ., Urbana.
A MODEL OF ELECTRONIC MAP INTERPRETATION
ANTHONY J. ARETZ (Illinois, University, Urbana) IN: Human Factors Society, Annual Meeting, 32nd, Anaheim, CA, Oct. 24-28, 1988, Proceedings. Volume 1. Santa Monica, CA, Human Factors Society, 1988, p. 130-134. refs
(Contract NAG2-308)

This paper describes an experiment that provides data for the development of a cognitive model of pilot flight navigation. The model views navigation as a process involving the alignment of mental images with the perceptual view out of the cockpit. The

data support a three stage model: (1) the perceptual encoding of the map display, (2) mental rotation of the mental image, and (3) comparison of the image to the environment. The variables that significantly influence the processes embodied in the model in decreasing importance are: speed of processing, display sequencing, map complexity, and rotation angle of the map. The model can be used as a preliminary computational tool in predicting the navigational component of pilot situational awareness.
Author

A89-31628
MENTAL MODELS - A FIFTH PARADIGM?
THOMAS J. HIGGINS and MARK H. CHIGNELL (Southern California, University, Los Angeles, CA) IN: Human Factors Society, Annual Meeting, 32nd, Anaheim, CA, Oct. 24-28, 1988, Proceedings. Volume 1. Santa Monica, CA, Human Factors Society, 1988, p. 145-149. refs

This paper describes ongoing research concerned with the development of a mental model for human pilots performing the final phases of an instrument landing approach. The results of three experiments are reported. The first experiment (reported more extensively by Higgins and Chignell, 1987) was used to select the parameters used in the subsequent experiments. The second experiment tested the validity of collecting verbal protocols during simulated instrument landings, while the third experiment studied the behavior of pilots when a wind condition, and additional information, are introduced to the task. In the third experiment, theoretically useful information was provided by an experimenter simulating the advice that would be given by an expert system. However, the results of this experiment showed that information hurt, rather than helped, performance. Verbal protocols were also collected in the three experiments.
Author

A89-31629* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
TRANSPORT PILOT WORKLOAD - A COMPARISON OF TWO SUBJECTIVE TECHNIQUES
VERNOL BATTISTE (NASA, Ames Research Center, Moffett Field, CA) and MICHAEL BORTOLUSSI (Western Aerospace Laboratories, Inc., Moffett Field, CA) IN: Human Factors Society, Annual Meeting, 32nd, Anaheim, CA, Oct. 24-28, 1988, Proceedings. Volume 1. Santa Monica, CA, Human Factors Society, 1988, p. 150-154. refs

Although SWAT and NASA-TLX workload scales have been compared on numerous occasions, they have not been compared in the context of transport operations. Transport pilot workload has traditionally been classified as long periods of low workload with occasional spikes of high workload. Thus, the relative sensitivity of the scales to variations in workload at the low end of the scale were evaluated. This study was a part of a larger study which investigated workload measures for aircraft certification, conducted in a Phase II certified Link/Boeing 727 simulator. No significant main effects were found for any performance-based measures of workload. However, both SWAT and NASA-TLX were sensitive to differences between high and low workload flights and to differences among flight segments. NASA-TLX (but not SWAT) was sensitive to the increase in workload during the cruise segment of the high workload flight. Between-subject variability was high for SWAT. NASA-TLX was found to be stable when compared in the test/retest paradigm. A test/retest by segment interaction suggested that this was not the case for SWAT ratings.
Author

A89-31630
TECHNIQUES OF SUBJECTIVE ASSESSMENT - A COMPARISON OF THE SWAT AND MODIFIED COOPER-HARPER SCALES
KEVIN J. KILMER, ROBERT KNAPP, CHARLES BURDSAL, JR., ROBERT BORRESEN (Wichita State University, KS), ROBERT BATEMAN (Boeing Military Airplane Co., Crew Systems Div., Wichita, KS) et al. IN: Human Factors Society, Annual Meeting, 32nd, Anaheim, CA, Oct. 24-28, 1988, Proceedings. Volume 1. Santa Monica, CA, Human Factors Society, 1988, p. 155-159. refs

This study examined two subjective mental workload assessment scales, the Subjective Workload Assessment Technique (SWAT) and the Modified Cooper-Harper (MCH) Scale. The purpose of this study was to make a direct comparison of the two scales in order to determine if both scales were equally sensitive to changes in task difficulty, hence, workload. Forty introductory psychology non-aviator students were trained on an aviation-like psychomotor dual-task experiment. Task difficulty was manipulated by presenting the subjects with three (low, moderate, high) levels of wind gust disturbance (turbulence) and requiring them to maintain an assigned altitude and airspeed, while responding to a visual choice reaction time secondary task. The data was analyzed using multivariate statistics. The results of the analysis found that both the SWAT and MCH were sensitive to changes in task difficulty. However, the MCH appeared to be less sensitive than the SWAT.
Author

A89-31631* Illinois Univ., Urbana.
TASKILLAN - A SIMULATION TO PREDICT THE VALIDITY OF MULTIPLE RESOURCE MODELS OF AVIATION WORKLOAD
CHRISTOPHER D. WICKENS, KELLY HARWOOD, LEON SEGAL, INGE TKALCEVIC, and BILL SHERMAN (Illinois, University, Urbana) IN: Human Factors Society, Annual Meeting, 32nd, Anaheim, CA, Oct. 24-28, 1988, Proceedings. Volume 1. Santa Monica, CA, Human Factors Society, 1988, p. 168-172. refs
(Contract NAG2-308)

A study to establish the validity of five predictive models of workload in the context of a controlled helicopter mission, TASKILLAN, is presented. Ten subjects performed simulations involving combinations of a low level flight task with three cognitive side tasks pertaining to navigation, spatial awareness, and computation. It is found that the best predictors of subjective workload are relatively simple models that integrate the total demands of task over time.
R.B.

A89-31632
STRESS AND PILOT JUDGMENT - AN EMPIRICAL STUDY USING MIDIS, A MICROCOMPUTER-BASED SIMULATION
CHRISTOPHER D. WICKENS, ALAN F. STOKES, BARBARA BARNETT, and FRED HYMAN (Illinois, University, Urbana) IN: Human Factors Society, Annual Meeting, 32nd, Anaheim, CA, Oct. 24-28, 1988, Proceedings. Volume 1. Santa Monica, CA, Human Factors Society, 1988, p. 173-177. Research supported by DOE and USAF. refs

An information processing framework is presented for predicting the effects of stress manipulations on pilot decision making, including stressors related to anxiety, time pressure, and high risk situations. The predictions are tested on MIDIS, a microcomputer-based pilot decision simulator. Performance of ten subjects under conditions of noise, concurrent task loading, time pressure, and financial risk are compared with performance of ten subjects in a control group. The framework predicts that these stressors restrict the range of cue sampling and reduce the capacity of working memory, but do not affect decisions based on direct retrieval of knowledge from long term memory.
R.B.

A89-31633
AN EMPIRICALLY VALIDATED TASK ANALYSIS (EVTA) OF LOW LEVEL ARMY HELICOPTER OPERATIONS
MARGARET T. SHAFFER (Paradigm, Inc., Potomac, MD), KEITH C. HENDY (Defence and Civil Institute of Environmental Medicine, Downsview, Canada), and LOU R. WHITE (Canadian Marconi Co., Kanata, Canada) IN: Human Factors Society, Annual Meeting, 32nd, Anaheim, CA, Oct. 24-28, 1988, Proceedings. Volume 1. Santa Monica, CA, Human Factors Society, 1988, p. 178-182. Sponsorship: Department of Supply and Services of Canada. refs
(Contract DSS-01SE-W7711-7-7002)

A computer-based Empirically Validated Task Analysis (EVTA) of Canadian Forces light observation helicopter operations was conducted from video records of cockpit activity gathered during

flight. The task analysis was performed in order to provide data for function analysis and workload prediction studies in support of the Canadian Forces Light Helicopter replacement project. Observable behaviors were categorized according to the type of activity involved and communications were analyzed for content, agencies involved, and relevance to the crew's task. The results of this study indicate that data gathered from a controlled test environment can differ considerably from those obtained in operational settings and that miniature video cameras can be useful in obtaining information from environments which hitherto may have been inaccessible to all but operational personnel. Author

A89-31634* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
FIELD STUDY OF COMMUNICATION AND WORKLOAD IN POLICE HELICOPTERS - IMPLICATIONS FOR AI COCKPIT DESIGN
CHARLOTTE LINDE (NASA, Ames Research Center, Moffett Field, CA) and ROBERT J. SHIVELY (NASA, Ames Research Center; U.S. Army, Aeroflightdynamics Directorate, Moffett Field, CA) IN: Human Factors Society, Annual Meeting, 32nd, Anaheim, CA, Oct. 24-28, 1988, Proceedings. Volume 1. Santa Monica, CA, Human Factors Society, 1988, p. 237-241. refs

This paper reports on the work performed by civilian helicopter crews, using audio and video recordings and a variety of workload measures (heart rate and subjective ratings) obtained in a field study of public service helicopter missions. The number and frequency of communications provided a significant source of workload. This is relevant to the design of automated cockpit systems, since many designs presuppose the use of voice I/O systems. Fluency of communications (including pauses, hesitation markers, repetitions, and false starts) furnished an early indication of the effects of fatigue. Three workload measures were correlated to identify high workload segments of flight, and to suggest alternate task allocations between crew members. Author

A89-31636* Georgia Inst. of Tech., Atlanta.
INTENT INFERENCING BY AN INTELLIGENT OPERATOR'S ASSOCIATE - A VALIDATION STUDY
PATRICIA M. JONES (Georgia Institute of Technology, Atlanta) IN: Human Factors Society, Annual Meeting, 32nd, Anaheim, CA, Oct. 24-28, 1988, Proceedings. Volume 1. Santa Monica, CA, Human Factors Society, 1988, p. 409-413. refs
(Contract NAS5-28575; NAG2-413)

In the supervisory control of a complex, dynamic system, one potential form of aiding for the human operator is a computer-based operator's associate. The design philosophy of the operator's associate is that of 'amplifying' rather than automating human skills. In particular, the associate possesses understanding and control properties. Understanding allows it to infer operator intentions and thus form the basis for context-dependent advice and reminders; control properties allow the human operator to dynamically delegate individual tasks or subfunctions to the associate. This paper focuses on the design, implementation, and validation of the intent inferencing function. Two validation studies are described which empirically demonstrate the viability of the proposed approach to intent inferencing. Author

A89-31637
VALIDATION OF A COMPUTER-BASED AVIATION SECONDARY SELECTION SYSTEM FOR STUDENT NAVAL AVIATORS
G. D. GIBB and D. L. DOLGIN (U.S. Navy, Naval Aerospace Medical Research Laboratory, Pensacola, FL) IN: Human Factors Society, Annual Meeting, 32nd, Anaheim, CA, Oct. 24-28, 1988, Proceedings. Volume 2. Santa Monica, CA, Human Factors Society, 1988, p. 807-811.

Results are presented from a study conducted by means of a test-battery for the automated selection of naval aircrews that measures cognitive processes, psychomotor skills, and time-sharing abilities. The study involved participation by 454 student naval aviators aged 20-29 with an average of 26.64 hours of previous flight time. Two sets of data are presented: the first gives descriptive statistics and individual correlations between test measures and two criterion measures, while the second encompasses results from multiple-regression analyses that include standard naval aviation selection test scores, demographic and biographical information, and test-battery measures associated with each of the criterion measures. O.C.

A89-31638
EVALUATION OF AN AUTOMATED SERIES OF SINGLE AND MULTIPLE-PSYCHOMOTOR AND DICHOTIC LISTENING TASKS
GLENN R. GRIFFIN (U.S. Navy, Naval Aerospace Medical Research Laboratory, Pensacola, FL) IN: Human Factors Society, Annual Meeting, 32nd, Anaheim, CA, Oct. 24-28, 1988, Proceedings. Volume 2. Santa Monica, CA, Human Factors Society, 1988, p. 812-816.

The performance-based selection and classification of naval aviators is presently approached by means of a desktop computer-based system for automated single and multiple tasks. Descriptive statistics and correlational reliability estimates are generated for two series of single and multiple automated tasks. One series of the psychomotor single task incorporated psychomotor stick-and-rudder movements corresponding to respective cursor movements on a CRT, while the other involved stick-and-rudder movements opposite to the CRT cursor movement. The other single task involved dichotic listening. In the multitask conditions, subjects performed three sessions of psychomotor and dichotic activities simultaneously. O.C.

A89-31639
CURRENT DEVELOPMENTS IN RESEARCH ON AIR FORCE PILOT CHARACTERISTICS
FREDERICK M. SIEM (USAF, Human Resources Laboratory, Brooks AFB, TX) IN: Human Factors Society, Annual Meeting, 32nd, Anaheim, CA, Oct. 24-28, 1988, Proceedings. Volume 2. Santa Monica, CA, Human Factors Society, 1988, p. 817-821. refs

A personality inventory was given to 509 USAF pilot candidates. The items were combined into five measures, two of which differentiated training successes from failures; graduates demonstrated higher self-confidence and less dogmatism. As an alternative approach to examining simple relationships between personality characteristics and training outcomes, personality profiles were examined as predictors of performance criteria. The value of this approach was demonstrated by better discrimination of training graduates from non-graduates. The implication of these results are discussed, as are plans for other research projects designed to replicate and extend the findings from the current study. Author

A89-31641
USING ROBUST STATISTICS AND DISTRIBUTION PARAMETERS TO ESTABLISH VALID INDIVIDUAL DIFFERENCES IN COMPUTER-BASED COGNITIVE TESTING
BENJAMIN A. FAIRBANK, JR. (Operational Technologies Corp., San Antonio, TX) IN: Human Factors Society, Annual Meeting, 32nd, Anaheim, CA, Oct. 24-28, 1988, Proceedings. Volume 2. Santa Monica, CA, Human Factors Society, 1988, p. 831-835. Research supported by USAF. refs

A89-31642
SLOPE-CONTROLLED PERFORMANCE TESTING
MARSHALL B. JONES (Pennsylvania State University, Hershey) IN: Human Factors Society, Annual Meeting, 32nd, Anaheim, CA, Oct. 24-28, 1988, Proceedings. Volume 2. Santa Monica, CA, Human Factors Society, 1988, p. 836, 837. refs
(Contract MDA903-83-K-0286; AF-AFOSR-87-0216)

Cognitive-ability tests, though promising in other respects, generally show pronounced practice effects and have weak test-retest reliabilities. One reason for the low reliabilities appears to be that practice effects themselves vary from individual to individual, so that subjects differ not only in the levels at which they are performing when testing ends but also in the slopes

leading up to those levels. Since slope of the performance curve late in practice has been shown to affect performance at reacquisition (retest), uncontrolled variation in slope may lower test-retest reliability. A possible approach to this problem is experimentally to control slope during testing so that all subjects are improving at roughly the same rates when testing ends. The expected effect is that, with inter-subject differences in slope controlled , the temporal stability of cognitive-ability tests will improve. If temporal stability improves, however, predictive validities ought also to improve. Author

A89-31644
FACTORS IN PREDICTING SUCCESS IN THE ACQUISITION OF COGNITIVE SKILL
PATRICK C. KYLLONEN (Georgia, University, Athens; USAF, Human Resources Laboratory, San Antonio, TX) IN: Human Factors Society, Annual Meeting, 32nd, Anaheim, CA, Oct. 24-28, 1988, Proceedings. Volume 2. Santa Monica, CA, Human Factors Society, 1988, p. 843-847. refs

Results are presented from two studies that have attempted to ascertain the relationship between performance on basic cognitive tasks, as administered on microcomputers, and performance on two learning tasks; of these, one involved computer programming, while the other traced signals through logic gates. It is assumed in light of previous results that individual differences are functions of (1) processing speed; (2) processing capacity; (3) breadth, extent, and accessibility of conceptual knowledge; and (4) procedural and strategic skills. Skill-acquisition proficiency was decomposed into separate scores for speed of acquisition of the 'facts', and speed of acquisition of knowledge-application to problems. Working memory capacity is found by both studies to be the best predictor of both acquisition speeds. O.C.

A89-31645* University of Southern California, Los Angeles.
ESTIMATION OF DURATION AND MENTAL WORKLOAD AT DIFFERING TIMES OF DAY BY MALES AND FEMALES
P. A. HANCOCK, G. J. RODENBURG, W. D. MATHEWS, and M. VERCRUYSSEN (Southern California, University, Los Angeles, CA) IN: Human Factors Society, Annual Meeting, 32nd, Anaheim, CA, Oct. 24-28, 1988, Proceedings. Volume 2. Santa Monica, CA, Human Factors Society, 1988, p. 857-861. refs
(Contract NCC2-379)

Two experiments are reported which investigated whether male and female operator duration estimation and subjective workload followed conventional circadian fluctuation. In the first experiment, twenty-four subjects performed a filled time-estimation task in a constant blacked-out, noise-reduced environment at 0800, 1200, 1600, and 2000 h. In the second experiment, twelve subjects performed an unfilled time estimation task in similar conditions at 0900, 1400, and 1900 h. At the termination of all experimental sessions, participants completed the NASA TLX workload assessment questionnaire as a measure of perceived mental workload. Results indicated that while physiological response followed an expected pattern, estimations of duration and subjective perception of workload showed no significant effects for time-of-day. In each of the experiments, however, there were significant differences in durational estimates and mental workload response depending upon the gender of the participant. Results are taken to support the assertion that subjective workload is responsive largely to task-related factors and indicates the important differences that may be expected due to operator gender. Author

A89-31647
INDIVIDUAL DIFFERENCES IN VISUAL PERCEPTUAL PROCESSING - ATTENTION, INTELLIGENCE, AND DISPLAY CHARACTERISTICS
LILA F. LAUX and DAVID M. LANE (Rice University, Houston, TX) IN: Human Factors Society, Annual Meeting, 32nd, Anaheim, CA, Oct. 24-28, 1988, Proceedings. Volume 2. Santa Monica, CA, Human Factors Society, 1988, p. 867-871. refs

A89-31648
MODEL FOR MEASURING COMPLEX PERFORMANCE IN AN AVIATION ENVIRONMENT
HEIDI ANN HAHN (Idaho National Engineering Laboratory, Idaho Falls) IN: Human Factors Society, Annual Meeting, 32nd, Anaheim, CA, Oct. 24-28, 1988, Proceedings. Volume 2. Santa Monica, CA, Human Factors Society, 1988, p. 875-878. Research supported by USAF.

An experiment was conducted to identify models of pilot performance through the attainment and analysis of concurrent verbal protocols. Sixteen models were identified. Novice and expert pilots differed with respect to the models they used. Models were correlated to performance, particularly in the case of expert subjects. Models were not correlated to performance shaping factors (i.e., workload). Author

A89-31649
FUNCTIONAL MODELS OF COMPLEX HUMAN PERFORMANCE - APPLICATION TO THE ASSESSMENT OF PILOT PERFORMANCE
WILLIAM R. NELSON (Idaho National Engineering Laboratory, Idaho Falls) IN: Human Factors Society, Annual Meeting, 32nd, Anaheim, CA, Oct. 24-28, 1988, Proceedings. Volume 2. Santa Monica, CA, Human Factors Society, 1988, p. 879-882. Research supported by USAF.
(Contract DE-AC07-76ID-01570)

A method has been developed for formulating integrated models of complex human and machine performance. The functional models can be used to model human tasks, measure human performance, identify problem solving strategies, estimate human error probabilities, define training requirements, investigate accidents, and design decision aids for complex cognitive tasks. This paper summarizes the application of the functional modeling technique to collection and analyis of data from an experiment designed to assess pilot performance while responding to malfunctions. Author

A89-31651
INDIVIDUAL DIFFERENCES IN FLIGHT SIMULATION PERFORMANCE EXPERIMENTS
MARGARET D. NOLAN, LAWRENCE J. HETTINGER, ROBERT S. KENNEDY, and KATRINA M. EDINGER (Essex Corp., Orlando, FL) IN: Human Factors Society, Annual Meeting, 32nd, Anaheim, CA, Oct. 24-28, 1988, Proceedings. Volume 2. Santa Monica, CA, Human Factors Society, 1988, p. 1001-1005. refs

In a review of flight simulation performance experiments conducted at the U.S. Navy's Visual Technology Research Simulator (VTRS), it was observed that individual difference variables accounted for a major portion of the total explained variance, in many cases more than the simulator equipment variables that were deliberately manipulated. This finding underscores the importance of individual differences in performance and training research in support of man-machine systems development and implementation. The identification of the substrates underlying individual differences will impact on equipment design considerations and training program requirements for military and industrial systems. Author

A89-31652
EVALUATION OF COGNITIVE FUNCTION IN AVIATORS
ALAN F. STOKES, MARIE T. BANICH, VALORIE C. ELLEDGE, and YING KE (Illinois, University, Urbana) IN: Human Factors Society, Annual Meeting, 32nd, Anaheim, CA, Oct. 24-28, 1988, Proceedings. Volume 2. Santa Monica, CA, Human Factors Society, 1988, p. 1011-1015. refs
(Contract DOT-FA02-87-DT-068)

Results are presented from an experimental evaluation of four 'mini mental exam' test batteries capable of screening commercial aviation flight crews for cognitive impairment due to substance abuse, mental illness, or neuropsychopathology. Attention is given to the prototype version of an automated screening battery, the Simple, Portable Aviation-Relevant Test-battery and Answer-scoring System, or 'SPARTANS', and to the Illinois Screening Test (IST)

pencil-and-paper test battery. The results of the present evaluation suggest a deletion of the poorer-performing subtasks in SPARTAN and the automation of the best-performing subtasks in IST. O.C.

A89-31659
A PHYSICAL MEASURE OF SUBJECTIVE WORKLOAD
DAVID W. BIERS, DONALD J. POLZELLA, and PAUL MCINERNEY (Dayton, University, OH) IN: Human Factors Society, Annual Meeting, 32nd, Anaheim, CA, Oct. 24-28, 1988, Proceedings. Volume 2. Santa Monica, CA, Human Factors Society, 1988, p. 1131-1135. refs

The investigation compared a physical measure of subjective workload (i.e., hand dynamometer) with traditional verbal scaling techniques. There were four subjective rating groups. One group employed the Subjective Workload Assessment Technique (SWAT) which required three separate ratings of time stress, mental effort, and psychological stress. A second group used verbal magnitude estimation (ME). Two physical measure groups estimated the magnitude of workload by squeezing a dynamometer in accordance with the magnitude of workload experienced. The DYNAL group made one overall rating of workload similar to the ME group. The DYNA3 group made three workload ratings along the same dimensions as SWAT. All groups rated the workload associated with the performance of a continuous memory task under twelve levels of task difficulty. The physical measure of subjective workload most closely corresponded to actual task performance differences. The results suggest future development of a physical measure of subjective workload which can be utilized on a continuous basis, thus avoiding a major shortcoming of typical verbal measures of subjective workload. Author

A89-31660
AN ALTERNATIVE TO MEASURING SUBJECTIVE WORKLOAD - USE OF SWAT WITHOUT THE CARD SORT
DAVID W. BIERS and PAUL MCINERNEY (Dayton, University, OH) IN: Human Factors Society, Annual Meeting, 32nd, Anaheim, CA, Oct. 24-28, 1988, Proceedings. Volume 2. Santa Monica, CA, Human Factors Society, 1988, p. 1136-1139.

One major drawback in some applications of the Subjective Workload Assessment Technique (SWAT) is the time required to administer the card sort. There are alternative methods of forming a workload composite from the SWAT instrument (i.e., a simple sum of the three scales or composite derived from multivariate statistics) which do not require the card sort. The present study compared the sensitivity of these alternative SWAT composite measures with the typical SWAT conjoint scaling metric which requires the card sort. A two group study was conducted in which subjects engaged in a continuous recognition task under twelve levels of task difficulty. One group (Pre-Task), performed the card sort prior to engaging in the task whereas in the other group (Post-Task) completed the card sort subsequent to task performance. Results indicated that placement of the card sort did not affect the task ratings on the three dimensions of SWAT nor did it affect the relative sensitivity of the three workload composites. All three composite measures were found equally sensitive to the task demands. These results indicate that the SWAT instrument can be used to effectively measure workload without having to perform the card sort. Author

A89-31661
WORKLOAD ASSESSMENT OF A REMOTELY PILOTED VEHICLE (RPV) SYSTEM
JAMES C. BYERS, ALVAH C. BITTNER, JR., SUSAN G. HILL, ALLEN L. ZAKLAD (Analytics, Inc., Willow Grove, PA), and RICHARD E. CHRIST (U.S. Army, Research Institute, Fort Bliss, TX) IN: Human Factors Society, Annual Meeting, 32nd, Anaheim, CA, Oct. 24-28, 1988, Proceedings. Volume 2. Santa Monica, CA, Human Factors Society, 1988, p. 1145-1149. refs
(Contract MDA903-86-C-0384)

The NASA 'TLX', 'SWAT', 'Overall Workload' (OW), and Modified Cooper-Harper (MCH) operator-workload scales are presently applied to ground-control operations of the Aquila RPV, generating 17 sets of individual assessments of mission segments by the four members of each of four crews and one replacement crewman. A consistent ordering of decreasing factor loadings, namely TLX (0.910), SWAT (0.893), OW (0.869), and MCH (0.833) is discovered. Attention is also given to several variables of the composite workload factor scores; significant results reflecting upon both the system and its test are obtained. O.C.

A89-31662
EFFECTS OF 'WORKAROUNDS' ON PERCEPTIONS OF PROBLEM IMPORTANCE DURING OPERATIONAL TEST
JOHN F. COURTRIGHT, WILLIAM H. ACTON (BDM Corp., Albuquerque, NM), MICHAEL L. FRAZIER, and J. WALTER LANE (USAF, Operational Test and Evaluation Center, Kirtland AFB, NM) IN: Human Factors Society, Annual Meeting, 32nd, Anaheim, CA, Oct. 24-28, 1988, Proceedings. Volume 2. Santa Monica, CA, Human Factors Society, 1988, p. 1150-1153.
(Contract F29601-85-C-0058)

'Workarounds' are nonstandard procedures operators devise to compensate for system deficiences. This study investigated the impact of workarounds on the perceived importance of problems discovered during operational test. Questionnaire data were collected for 73 reported design deficiencies to assess the existence and effectiveness of workarounds and the importance of the tasks they affected to mission success. Problems were viewed as more important when workarounds were ineffective or time consuming, and when the tasks affected were deemed critical to mission success. Implications for problem prioritization are discussed. Author

A89-31664
DEVELOPMENT OF AN AIR COMBAT PERFORMANCE MEASURE
GARY S. THOMAS (Dayton, University, Williams AFB, AZ) and DAVID C. MILLER (Logicon, Inc., Luke AFB, AZ) IN: Human Factors Society, Annual Meeting, 32nd, Anaheim, CA, Oct. 24-28, 1988, Proceedings. Volume 2. Santa Monica, CA, Human Factors Society, 1988, p. 1207-1211. refs

An attempt was made to formulate a unitary measure of performance for simulated one-versus-one, within visual range, air-to-air combat. Two experiments were carried out in which fighter pilots rank-ordered hypothetical air combat maneuvering engagement outcomes from most to least desirable. Attention was given to: (1) whether or not the hypothetical pilot achieved a 'kill'; (2) whether or not he survived the mission; (3) the amount of time the pilot was in an offensive, defensive, or neutral posture; (4) length of engagement; and (5) position at the beginning and end of the engagement. K.K.

A89-31665
APPLICATION OF AUTOMATIC/CONTROLLED PROCESSING THEORY TO TRAINING TACTICAL COMMAND AND CONTROL SKILLS. I - BACKGROUND AND TASK ANALYTIC METHODOLOGY
ARTHUR D. FISK (Georgia Institute of Technology, Atlanta) and F. THOMAS EGGEMEIER (Dayton, University, OH) IN: Human Factors Society, Annual Meeting, 32nd, Anaheim, CA, Oct. 24-28, 1988, Proceedings. Volume 2. Santa Monica, CA, Human Factors Society, 1988, p. 1227-1231. refs
(Contract F33615-85-C-0010)

The laboratory research that provided the theoretical and empirical underpinnings for the development of a task-analytic training methodology is reviewed. The actual task-analytic methodology, developed to decompose tasks performed to support tactical command and control, air-weapons controller missions, is briefly discussed. The present paper provides the necessary background for the actual application of the methodology. Author

A89-31666
APPLICATION OF AUTOMATIC/CONTROLLED PROCESSING THEORY TO TRAINING TACTICAL COMMAND AND CONTROL SKILLS. II - EVALUATION OF A TASK ANALYTIC METHODOLOGY

F. THOMAS EGGEMEIER (Dayton, University, OH), RICHARD J. ROBBINS (Systems Exploration, Inc., Dahlgren, VA), ARTHUR D. FISK (Georgia Institute of Technology, Atlanta), and MICHAEL T. LAWLESS (USAF, Human Resources Laboratory, Wright-Patterson AFB, OH) IN: Human Factors Society, Annual Meeting, 32nd, Anaheim, CA, Oct. 24-28, 1988, Proceedings. Volume 2. Santa Monica, CA, Human Factors Society, 1988, p. 1232-1236. refs
(Contract F33615-85-C-0010)

A89-31667
SIMULATOR EVALUATION OF INSTRUCTIONAL AND DESIGN FEATURES FOR TRAINING HELICOPTER SHIPBOARD LANDING
DANIEL J. SHEPPARD, SHERRIE A. JONES, DANIEL P. WESTRA (Essex Corp., Orlando, FL), and JOYCE J. MADDEN (U.S. Navy, Naval Training Systems Center, Orlando, FL) IN: Human Factors Society, Annual Meeting, 32nd, Anaheim, CA, Oct. 24-28, 1988, Proceedings. Volume 2. Santa Monica, CA, Human Factors Society, 1988, p. 1261-1265.
(Contract N61339-85-D-0026)

The effects of four instructional issues and one simulator design feature for training helicopter shipboard landing on small ships were studied in the VTOL at the Visual Technology Research Simulator Naval Training Systems Center. These were FOV, task chaining, augmented cueing, length of training, and the timing of seastate introduction. The experiment used an in-simulator transfer-of-training paradigm in which pilots who were not proficient in the helicopter shipboard landing task were trained under one of several experimental conditions and then tested on the transfer condition in the simulator. Of the experimental instruction issues, task chaining had the largest effect, with better performance in all segments of the task for pilots who received whole task training. K.K.

A89-31668
EFFECT OF THREE-DIMENSIONAL OBJECT TYPE AND DENSITY IN SIMULATED LOW-LEVEL FLIGHT
JAMES A. KLEISS, DAVID G. CURRY, and DAVID C. HUBBARD (Dayton, University, OH) IN: Human Factors Society, Annual Meeting, 32nd, Anaheim, CA, Oct. 24-28, 1988, Proceedings. Volume 2. Santa Monica, CA, Human Factors Society, 1988, p. 1299-1303. refs

Three-dimensional objects placed on simulated terrain surfaces are particularly effective as cues for altitude in simulated low-level flight. To conserve the limited edge processing capacity of computer image generators (CIGs), objects have typically been simple in shape and therefore fairly abstract in appearance. The present investigation sought to determine whether the apparent size of more detailed and familiar appearing objects (e.g., trees and bushes) serves as an additional cue for altitude in simulated low-level flight. Results showed no differences in performance between abstract objects and familiar objects. However, performance did improve with increases in object density, at least for some performance measures. These results suggest that CIG processing capacity may be most effectively utilized by increasing object density rather than individual object detail. Author

A89-31669
A SIGNAL DETECTION PARADIGM FOR COLOR DISPLAY SPECIFICATION
DENISE L. WILSON, GILBERT G. KUPERMAN (USAF, Aerospace Medical Research Laboratory, Wright-Patterson AFB, OH), ERIC G. RAMSEY, and WILLIAM A. PEREZ (Systems Research Laboratories, Inc., Dayton, OH) IN: Human Factors Society, Annual Meeting, 32nd, Anaheim, CA, Oct. 24-28, 1988, Proceedings. Volume 2. Santa Monica, CA, Human Factors Society, 1988, p. 1329-1333. Research sponsored by USAF. refs

The validity of signal detection theory to the assessment of displayed color symbology is demonstrated for the design specification of color-coded symbology for moving map, situational awareness displays. An experiment was designed to determine the distance between symbol and background color required for observers to detect that a symbol is present against the background. The methods used are successful in separating the cognitive and sensory/perceptual factors associated with color-on-color detection. R.B.

A89-31673
THE EFFECTS OF BIODYNAMIC STRESS ON WORKLOAD IN HUMAN OPERATORS
WILLIAM B. ALBERY (USAF, Aerospace Medical Research Laboratory, Wright-Patterson AFB, OH), MERRY M. ROE, CHARLES D. GOODYEAR, and KATHY A. MCCLOSKEY (Systems Research Laboratories, Inc., Dayton, OH) IN: Human Factors Society, Annual Meeting, 32nd, Anaheim, CA, Oct. 24-28, 1988, Proceedings. Volume 2. Santa Monica, CA, Human Factors Society, 1988, p. 1409-1413. refs

The objective of this research was to assess the effects of two biodynamic stressors, noise and acceleration, commonly experienced in the aircraft cockpit, on human operator performance and workload. Thirteen workload measures, including one subjective, four performance and eight physiological, were recorded on subjects performing a dual psychomotor task. The results indicate that biodynamic stressors such as noise and acceleration can adversely affect subjective operator workload without affecting objective task performance. Author

A89-31674
CRITICAL SWAT VALUES FOR PREDICTING OPERATOR OVERLOAD
GARY B. REID (USAF, Aerospace Medical Research Laboratory, Wright-Patterson AFB, OH) and HERBERT A. COLLE (Wright State University, Dayton, OH) IN: Human Factors Society, Annual Meeting, 32nd, Anaheim, CA, Oct. 24-28, 1988, Proceedings. Volume 2. Santa Monica, CA, Human Factors Society, 1988, p. 1414-1418. refs

The Subjective Workload Assessment Technique (SWAT) has been used to assess mental workload in a variety of situations. As with subjective techniques generally, use of SWAT has emphasized relative comparisons of task conditions. For example, it has been possible to determine if one task or display required a greater mental workload than another. For many applications, however, it would be useful to have identified a critical SWAT level that indicates likely performance degradation caused by operator overload. A review of previously completed studies suggests a range of SWAT scores that were predictive of operator overload. Author

A89-31677* Illinois Univ., Urbana.
PERCEIVED CHANGE IN ORIENTATION FROM OPTIC FLOW IN THE CENTRAL VISUAL FIELD
BRIAN P. DYRE and GEORGE J. ANDERSEN (Illinois, University, Urbana) IN: Human Factors Society, Annual Meeting, 32nd, Anaheim, CA, Oct. 24-28, 1988, Proceedings. Volume 2. Santa Monica, CA, Human Factors Society, 1988, p. 1434-1438. refs
(Contract NSF BNS-86-07217; NAG2-308)

The effects of internal depth within a simulation display on perceived changes in orientation have been studied. Subjects monocularly viewed displays simulating observer motion within a volume of randomly positioned points through a window which limited the field of view to 15 deg. Changes in perceived spatial orientation were measured by changes in posture. The extent of internal depth within the display, the presence or absence of visual information specifying change in orientation, and the frequency of motion supplied by the display were examined. It was found that increased sway occurred at frequencies equal to or below 0.375 Hz when motion at these frequencies was displayed. The extent of internal depth had no effect on the perception of changing orientation. R.B.

A89-31678* Aerospace Medical Div. Aerospace Medical Research Labs. (6570th), Wright-Patterson AFB, OH.
A DISSOCIATION OF OBJECTIVE AND SUBJECTIVE WORKLOAD MEASURES IN ASSESSING THE IMPACT OF SPEECH CONTROLS IN ADVANCED HELICOPTERS
MICHAEL A. VIDULICH (USAF, Aerospace Medical Research

Laboratory, Wright-Patterson AFB, OH) and MICHAEL R. BORTOLUSSI (Western Aerospace Laboratories, Inc., Moffett Field, CA) IN: Human Factors Society, Annual Meeting, 32nd, Anaheim, CA, Oct. 24-28, 1988, Proceedings. Volume 2. Santa Monica, CA, Human Factors Society, 1988, p. 1471-1475. refs
(Contract NCC2-486)

Among the new technologies that are expected to aid helicopter designers are speech controls. Proponents suggest that speech controls could reduce the potential for manual control overloads and improve time-sharing performance in environments that have heavy demands for manual control. This was tested in a simulation of an advanced single-pilot, scout/attack helicopter. Objective performance indicated that the speech controls were effective in decreasing the interference of discrete responses during moments of heavy flight control activity. However, subjective ratings indicated that the use of speech controls required extra effort to speak precisely and to attend to feedback. Although the operational reliability of speech controls must be improved, the present results indicate that reliable speech controls could enhance the time-sharing efficiency of helicopter pilots. Furthermore, the results demonstrated the importance of using multiple assessment techniques to completely assess a task. Neither the objective nor the subjective measures alone provided complete information. It was the contrast between the measures that was most informative. Author

N89-19122# Psychometrics, Inc., Sherman Oaks, CA.
AIR FORCE OFFICER QUALIFYING TEST (AFOQT) FORM P: TEST CONSTRUCTION Interim Technical Report, Sep. 1983 - May 1986
FRANCES R. BERGER, WILLA B. GUPTA, and RAYMOND M. BERGER Oct. 1988 55 p
(Contract F33615-83-C-0035)
(AD-A200678; AFHRL-TR-88-30) Avail: NTIS HC A04/MF A01 CSCL 05H

Since 1951, the Air Force Officer Qualifying Test (AFOQT) has been part of the selection process for officer commissioning programs and pilot and navigator training. The latest of 15 successive forms of the AFOQT, Form O, contains 380 items organized into 16 subtests which form five composites: Pilot, Navigator Technical, Academic Aptitude, Verbal, and Quantitative. The anticipated need for future forms of the AFOQT prompted the development of a large pool of experimental items. Approximately 4,800 items were developed and administered (along with Form O items) to basic airmen and officer cadets attending military training programs. The immediate goal was to construct a follow-on AFOQT Form P in two parallel forms. Item analyses of the experimental test results provided item difficulty and discrimination data that helped to guide the selection of new and Form O items for Form P. Resemblance to Form O in psychometric properties, content, and style was the criterion for Form P item selection. Preliminary analyses of the newly constructed forms (P1 and P2) indicated that they were highly similar to each other as well as being comparable to Form O in content, item difficulty, and item discriminative power. GRA

N89-19123# Martingale Research Corp., Allen, TX.
BIOMASSCOMP: ARTIFICIAL NEURAL NETWORKS AND NEUROCOMPUTERS Final Report, 18 Aug. 1987 - 18 Feb. 1988
ROBERT L. DAWES Sep. 1988 196 p
(Contract F33615-87-C-1491)
(AD-A200902; MRC-WPAFB-88-001; AFWAL-TR-88-1076) Avail: NTIS HC A09/MF A01 CSCL 23C

BIOMASSCOMP is a project whose objective is to define and develop methods for automating the process of reverse engineering the brain for application to the development of intelligent sensors and controllers for avionic and other systems. Concepts which many neural network and cognitive researchers have assumed to work in self- organizing systems are quantified and applied. During this Phase 1 SBIR project, an entrropy-based scalar measure, DMORPH,of the common structure between two systems, as evidenced by measurement of signals from the two systems, have been defined, developed, and implemented. By design, DMORPH reflects only the crosscorrelations between systems and not the intracorrelations within the separate systems. DMORPH was applied to the input and output signals from various artificial neural network architectures to attempt to determine which networks, and which parameter settings within each, induced the greatest structural similarity between input and output signals after learning had taken place. This research applies to the development and testing of real time autonomous learning systems suitable for application to problems of avionics sensor fusion, adaptive sensor processing, and intelligent resource management. GRA

N89-19124# Naval Postgraduate School, Monterey, CA.
A MODEL THAT USES PSYCHOMOTOR TESTING TO PREDICT NAVAL AVIATOR PRIMARY FLIGHT GRADES M.S. Thesis
WALTER R. DECKER, JR. Sep. 1988 84 p
(AD-A201217) Avail: NTIS HC A05/MF A01 CSCL 05I

With the costs of pilot training escalating, it is becoming increasingly important to make as few mistakes as possible in the selection of potential aviators. In the early days of aviation the use of psychomotor testing played a big role in this selection process, but the physical complexities of the system caused its discontinuance. More recently, researchers at the Naval Aerospace Medical Research Laboratory, using micro-computers, have developed two new series of psychomotor tests. This thesis uses stepwise and multiple regression techniques to confirm the viability of using such a series of psychomotor tests to predict the flight grades of student aviators in primary flight school. The fitted regression model accounted for 77% of the variance in the primary flight grade data examined and appeared to be approximately 4.5 times better than the model currently used. GRA

N89-19125# Boston Univ., MA. Center for Adaptive Systems.
THE COGNITIVE, PERCEPTUAL, AND NEURAL BASES OF SKILLED PERFORMANCE Annual Report, 1 Oct. 1987 - 30 Sep 1988
STEPHEN GROSSBERG Sep. 1988 36 p
(Contract F49620-87-C-0018)
(AD-A201446; AFOSR-88-1275TR) Avail: NTIS HC A03/MF A01 CSCL 06D

The enclosed summaries provide an outline of some of the URI research projects. In addition to these activities, a scientific meeting combining URI scientists and other distinguished vision researchers in the USA and Canada was organized and held at Boston University in Mar 1988. Topics include: Probing cognitive processes through the structure of event-related potentials during learning; A neural network architecture for automatic trajectory formation and coordination of multiple effectors during variable-speed arm movements; Neural dynamics of planned arm movements: Emergent invariants and speed-accuracy properties during trajectory formation; Self-organizing neural architectures for eye movements, arm movements, and eye-arm coordination. GRA

N89-19126# Naval Medical Research Inst., Bethesda, MD.
NAVAL MEDICAL RESEARCH INSTITUTE PERFORMANCE ASSESSMENT BATTERY (NMRI PAB) DOCUMENTATION Technical Report, Oct. 1984 - Oct. 1986
JOHN R. THOMAS and JOHN SCHROT 1 Aug. 1988 60 p
(AD-A201654; NMRI-88-7) Avail: NTIS HC A04/MF A01 CSCL 05I

A cognitive performance assessment system developed for the evaluation of effects of operational Navy environments on performance is described. The performance assessment battery (NMRI-PAB) is made up of separate performance tests that each measure aspects of human cognitive functioning found to be important in critical tasks performed by Navy and Marine Corps personnel. The battery is designed to operate on a number of different standard microcomputer systems. The tests are administered by menu-driven computer programs and the administration of the battery can be learned easily by individuals not familiar with the performance assessment technology. The

NMRI-PAB reflects a general methodology developed within a tri service coordinated effort to provide standardized testing technology for the measurement of human performance in military environments. The report is a detailed description and specification of the assessment battery. GRA

N89-19805# Yale Univ., New Haven, CT. School of Medicine.
FEAR-POTENTIAL STARTLE AS A MODEL SYSTEM FOR ANALYZING LEARNING AND MEMORY Annual Report, 1 Jul. 1987 - 30 Jun. 1988
MICHAEL DAVIS 21 Sep. 1988 4 p
(Contract AF-AFOSR-0336-87; AF PROJ. 2312)
(AD-A201330; AFOSR-88-1171TR) Avail: NTIS HC A02/MF A01 CSCL 05H

Previous research has shown that the acoustic startle response, a simple reflex mediated by four synapsis in the brainstem and spinal cord, can be increased when elicited in the presence of a stimulus previously paired with a footshock. This fear-potentiated startle effect can be selectively blocked by drugs that decrease anxiety in humans as well as by lesions of the central nucleus of the amygdala, an area of the brain known to be critical for fear. This year it has been found that: (1) footshocks by themselves cause a marked increase in the startle reflex which appears to result from an activation of the central nucleus of the amygdala; (2) low level electrical stimulation of the central nucleus of the amygdala increases the acoustic startle reflex with a transit time of about 5 msec from the amygdala to the acoustic startle circuit; (3) a direct anatomical connection exists between the central nucleus of the nucleus of the amygdala and the acoustic startle pathway; and (4) lesions at several points along this pathway prevent a fear stimulus from potentiating the startle reflex. GRA

N89-19806# Massachusetts Inst. of Tech., Cambridge. Artificial Intelligence Lab.
STRUCTURAL SALIENCY: THE DETECTION OF GLOBALLY SALIENT STRUCTURES USING A LOCALLY CONNECTED NETWORK
SHIMON ULLMAN and AMNON SHAASHUA Jul. 1988 15 p
(Contract N00014-85-K-0124)
(AD-A201619; AI-M-1061) Avail: NTIS HC A03/MF A01 CSCL 06D

When we look at images, certain salient structures often attract our immediate attention without requiring a systematic scan of the entire image. In subsequent stages, processing resources can be allocated preferentially to these salient structures. In many cases this saliency is a property of the structure as a whole, i.e., parts of the structure are not salient in isolation. In this paper we present a saliency measure based on curvature and curvature variation. The structures this measure emphasizes are also salient in human perception, and they often correspond to objects of interest in the image. We present a method for computing the saliency by a simple iterative scheme, using a uniform network of locally connected processing elements. The network uses an optimization approach to produce a saliency map, which is a representation of the image emphasizing salient locations. The main properties of the network are: (1) the computations are simple and local, (2) globally salient structures emerge with a small number of iterations, and (3) as a by-product of the computations, contours are smoothed and gaps are filled in. GRA

N89-19857*# Vector Research, Inc., Ann Arbor, MI.
PSYCHOLOGICAL TOOLS FOR KNOWLEDGE ACQUISITION
HENRY H. RUETER and JUDITH REITMAN OLSON (Michigan Univ., Ann Arbor.) *In* NASA. Lyndon B. Johnson Space Center, 2nd Annual Workshop on Space Operations Automation and Robotics (SOAR 1988) p 293-297 Nov. 1988
Avail: NTIS HC A22/MF A01 CSCL 05I

Knowledge acquisition is said to be the biggest bottleneck in the development of expert systems. The problem is getting the knowledge out of the expert's head and into a computer. In cognitive psychology, characterizing metal structures and why experts are good at what they do is an important research area. Is there some way that the tools that psychologists have developed to uncover mental structure can be used to benefit knowledge engineers? We think that the way to find out is to browse through the psychologist's toolbox to see what there is in it that might be of use to knowledge engineers. Expert system developers have relied on two standard methods for extracting knowledge from the expert: (1) the knowledge engineer engages in an intense bout of interviews with the expert or experts, or (2) the knowledge engineer becomes an expert himself, relying on introspection to uncover the basis of his own expertise. Unfortunately, these techniques have the difficulty that often the expert himself isn't consciously aware of the basis of his expertise. If the expert himself isn't conscious of how he solves problems, introspection is useless. Cognitive psychology has faced similar problems for many years and has developed exploratory methods that can be used to discover cognitive structure from simple data. Author

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MAN/SYSTEM TECHNOLOGY AND LIFE SUPPORT

Includes human engineering; biotechnology; and space suits and protective clothing.

A89-29110
REPORT OF RESEARCH FORUM ON SPACE ROBOTICS AND AUTOMATION: EXECUTIVE SUMMARY
YOJI UMETANI, KAZUYA YOSHIDA (Tokyo Institute of Technology, Japan), YOSHIAKI OKAMI (National Aerospace Laboratory, Tokyo, Japan), MASARU UCHIYAMA (Tohoku University, Sendai, Japan), TSUTOMU IWATA (National Space Development Agency of Japan, Tokyo) et al. Research supported by the National Space Development Agency of Japan. Tokyo, Japan Space Utilization Promotion Center, 1988, 37 p.

A NASDA report on Japanese policies concerning space robotics and automation development is summarized. A scenario in which orbiting robots construct and operate space structures is presented and the element technologies needed to realize the scenario are discussed. Recommendations for Japanese policy are given, focusing on three project proposals: the construction of space structures using robots, the development of a space experiment module, and the creation of ground-based testing facilities for the performance evaluation and verification of space robots. R.B.

A89-29304* Jet Propulsion Lab., California Inst. of Tech., Pasadena.
REPRODUCIBLE ANALYSES OF MICROBIAL FOOD FOR ADVANCED LIFE SUPPORT SYSTEMS
GENE R. PETERSEN (California Institute of Technology, Jet Propulsion Laboratory, Pasadena) Enzyme and Microbial Technology (ISSN 0141-0229), vol. 10, Oct. 1988, p. 586-592. refs

The use of yeasts in controlled ecological life support systems (CELSS) for microbial food regeneration in space required the accurate and reproducible analysis of intracellular carbohydrate and protein levels. The reproducible analysis of glycogen was a key element in estimating overall content of edibles in candidate yeast strains. Typical analytical methods for estimating glycogen in Saccharomyces were not found to be entirely aplicable to other candidate strains. Rigorous cell lysis coupled with acid/base fractionation followed by specific enzymatic glycogen analyses were required to obtain accurate results in two strains of Candida. A profile of edible fractions of these strains was then determined. The suitability of yeasts as food sources in CELSS food production processes is discussed. Author

A89-29734
PROBLEMS AND RESULTS OF ERGONOMIC RESEARCH ON AVIATION [ZU PROBLEMEN UND ERGEBNISSEN DER ERGONOMISCHEN FORSCHUNG AUF DEM GEBIET DER FLIEGERISCHEN ARBEIT]
HORST MATERNA (Interflug Gesellschaft fuer Internationalen Flugverkehr mbH, Berlin, German Democratic Republic) Technisch-oekonomische Information der zivilen Luftfahrt (ISSN 0232-5012), vol. 24, no. 6, 1988, p. 199-201. In German.

Progress in aviation ergonomics is discussed. The relationship between flight safety and ergonomic research is examined, and the present needs of ergonomic research in aviation are reviewed. The state of the art in ergonomic research in civil aviation is described. C.D.

A89-29739
ASPECTS OF GUARANTEEING FLIGHT SAFETY VIA COCKPIT CREWS [EINIGE ASPEKTE ZUR GEWAEHRLEISTUNG DER FLUGSICHERHEIT DURCH DAS COCKPITPERSONAL]
ALEXANDER RIECHE (Berlin, Humboldt-Universitaet, German Democratic Republic) Technisch-oekonomische Information der zivilen Luftfahrt (ISSN 0232-5012), vol. 24, no. 6, 1988, p. 224-227. In German.

The safety problems involved in the relationship of cockpit crews to aircraft technology are outlined, and ways to ameliorate them are addressed. The contribution that individual crew members can make to flight safety are described. The importance of crew cooperation in increasing flight safety is stressed. C.D.

A89-29762#
MICROWAVE RADIATION HAZARDS FROM RADARS AND OTHER HIGH POWER MICROWAVE GENERATORS
J. P. GUPTA (Bhabha Atomic Research Centre, Bombay, India) Defence Science Journal (ISSN 0011-748X), vol. 38, July 1988, p. 287-292. refs

Surveys of high-power microwave generators and their transmission iines were performed to detect microwave radiation in the working enviroment. Biological effects of microwave radiation are described as well as safety limits. The hazards posed by mobile radars are found to be significantly greater than those posed by stationary radars mounted in immovable structures. K.K.

A89-31080#
MACHINE INTELLIGENCE AND CREW-VEHICLE INTERFACES
ROBERT G. EGGLESTON (USAF, Aerospace Medical Research Laboratory, Wright-Patterson AFB, OH) IN: Machine intelligence and autonomy for aerospace systems. Washington, DC, American Institute of Aeronautics and Astronautics, Inc., 1988, p. 51-87. refs

After a brief account of the development history of the crew-vehicle interface (CVI) for aeronautical systems, an evaluation is made of ways in which advancements in machine intelligence are influencing CVI design. Three alternative CVI design objectives (manual control; supervisory control; problem-solving) are discussed with a view to the ways in which machine intelligence technologies can be used to implement those objectives. Projections are then made of unresolved problems in CVI design. The discussion ranges over the definition of the interface, its design methodology, 'big picture' and 'supercockpit' CVI technologies, the DARPA Comprehensive Operator Support System, and the real-time performance of machine-intelligence techniques. O.C.

A89-31601
HUMAN FACTORS SOCIETY, ANNUAL MEETING, 32ND, ANAHEIM, CA, OCT. 24-28, 1988. PROCEEDINGS. VOLUMES 1 & 2
Meeting sponsored by the Human Factors Society. Santa Monica, CA, Human Factors Society, 1988, p. Vol. 1, 768 p.; vol. 2, 784 p. For individual items see A89-31602 to A89-31678.

Papers dealing with human factors in transportation are presented, covering topics such as pilot performance and simulation, Space Station design and performance, human factors design in special-purpose workstations for the Space Station, auditory spatial information and head-coupled display systems, situation awareness in aircraft systems, control and display issues, human factors in maintenance, aging, telephony and video teleconferencing, auditory and vocal communication, and aircrew station workload, design, and automation. Other subjects include approaches to user interface design, speech recognition systems, hypermedia and interfaces, the development of documentation in real time, computer screen and menu design, expert systems, human factors education, design of work environments, forensics issues, human factors and automobiles, industrial ergonomics, international technology transfer, organizational design and management, personality and human performance, mental models of complex performance, and gender, intelligence, and human performance. Additional topics include accident analysis, product safety, transportation safety, robotics/industrial safety, system development, the human-computer interface, human factors in navy systems, workload evaluation, training systems and data bases, skill aquisition, visual performance, information portrayal determinants of complex decision making, and advanced displays. R.B.

A89-31605
THE DYNAMIC SEAT AS AN ANGULAR MOTION CUING DEVICE
ROBERT K. OSGOOD, KELLY TAYLOR, and TERRENCE MCCLURG (Systems Research Laboratories, Inc., Dayton, OH) IN: Human Factors Society, Annual Meeting, 32nd, Anaheim, CA, Oct. 24-28, 1988, Proceedings. Volume 1. Santa Monica, CA, Human Factors Society, 1988, p. 25-29. refs
(Contract F33615-85-C-0541)

The use of dynamic seat as a motion cuing device to provide task-critical onset motion information on the roll axis is examined. An experiment to evaluate the drive laws developed for roll-axis cuing and to assess the performance of the drive laws developed for single axis tasks in multiaxis simulation. Twelve subjects controlled a compensatory tracking task including roll only, pitch only, and combined tasks. Performance was evaluated between four levels of drive algorithm across axis. Single axis tracking yielded better performance than dual axis tracking. The order of mean rms error for each of the tasks was consistent with previous results (Osgood, 1988). R.B.

A89-31607
FORECASTING CREW ANTHROPOMETRY FOR SHUTTLE AND SPACE STATION
JOHN ROEBUCK (Roebuck Research and Consulting, Santa Monica, CA), KIM SMITH, and LOUIS RAGGIO (Rockwell International Corp., Downey, CA) IN: Human Factors Society, Annual Meeting, 32nd, Anaheim, CA, Oct. 24-28, 1988, Proceedings. Volume 1. Santa Monica, CA, Human Factors Society, 1988, p. 35-39. refs

Habitation module and Crew Emergency Rescue Vehicle (CERV) designs for the International Space Station to be built by the United States are expected to accommodate a wide range of persons, according to body dimensions predicted for the year 2000. This prediction was aided by the opportunity, which arose in 1985, to check actual Space Shuttle male crew anthropometry, particularly stature, against predictions made circa 1973 and by recently acquired Japanese data. Revised hypotheses discussed herein have been accepted by an Anthropometry Working Group as the bases for developing anthropometry requirements that appear in the Man-Systems Integration Standard (NASA-STD-3000), published in 1987. Pleas are made for further research in civilian anthropometry and wider use of anthropometric forecasting. Author

A89-31608
THE HELMET-MOUNTED DISPLAY AS A TOOL TO INCREASE PRODUCTIVITY DURING SPACE STATION EXTRAVEHICULAR ACTIVITY
C. K. SHEPHERD, JR. (Lockheed Engineering and Sciences Co.,

Houston, TX) IN: Human Factors Society, Annual Meeting, 32nd, Anaheim, CA, Oct. 24-28, 1988, Proceedings. Volume 1. Santa Monica, CA, Human Factors Society, 1988, p. 40-43. refs

The human factors issues related to the helmet-mounted displays (HMDs) designed for the information system of the Space Station Extravehicular Mobility Unit are discussed. The amount and type of information that must be presented by the HMD and the physical capabilities of a suited astronaut are examined. A voice-interactive rapid prototyping system used to simulate and evaluate the use of the HMD in EVA is described. It is concluded that the HMD is safe for use in Space Station EVA. R.B.

A89-31609* Lockheed Engineering and Sciences Co., Houston, TX.

GUIDELINES FOR THE USE OF PROGRAMMABLE DISPLAY PUSHBUTTONS ON THE SPACE STATION'S TELEROBOT CONTROL PANEL

MARK A. STUART, RANDY L. SMITH, and ERVETTE P. MOORE (Lockheed Engineering and Sciences Co., Houston, TX) IN: Human Factors Society, Annual Meeting, 32nd, Anaheim, CA, Oct. 24-28, 1988, Proceedings. Volume 1. Santa Monica, CA, Human Factors Society, 1988, p. 44-48.

(Contract NAS9-17900)

Simulations of a Remote Manipulator System task on microcomputer prototypes were performed to establish guidelines for using programmable display pushbuttons (PDP) on a telerobot control panel. Simulations of control panels with and without PDP were conducted. It is shown that there is a statistically significant increase in the number of commands issued in the non-PDP control panel. Guidelines for using PDP panels are listed. R.B.

A89-31610* Lockheed Engineering and Sciences Co., Houston, TX.

PREVIOUS EXPERIENCE IN MANNED SPACE FLIGHT - A SURVEY OF HUMAN FACTORS LESSONS LEARNED

GEORGE O. CHANDLEE (Lockheed Engineering and Sciences Co., Houston, TX) and BARBARA WOOLFORD (NASA, Johnson Space Center, Houston, TX) IN: Human Factors Society, Annual Meeting, 32nd, Anaheim, CA, Oct. 24-28, 1988, Proceedings. Volume 1. Santa Monica, CA, Human Factors Society, 1988, p. 49-52. refs

(Contract NAS9-17900)

Human factors data from Apollo, Skylab, and Space Shuttle flights are reviewed. The sources of data and collection methods are described. A classification scheme for human factors data is proposed. The implications of the results for the design of the Space Station program are considered. R.B.

A89-31612

STEREOPSIS IN COCKPIT DISPLAY - A PART-TASK TEST

THOMAS C. WAY (Boeing Co., Seattle, WA) IN: Human Factors Society, Annual Meeting, 32nd, Anaheim, CA, Oct. 24-28, 1988, Proceedings. Volume 1. Santa Monica, CA, Human Factors Society, 1988, p. 58-62.

(Contract F33615-86-C-3601)

The benefit of adding retinal disparity to color raster display was tested with two formats. Six pilots flew a tracking task and periodically responded to 'failures' in the two represented systems, providing a total of 4320 trials. Response time and frequency were both reduced when disparity augmented monocular cues to 'real world' depth. Response time and error frequency were not affected when disparity was used to make an element of an otherwise flat display more noticeable. Author

A89-31613

AIRCREW RECOMMENDATIONS FOR VOICE MESSAGE FUNCTIONS IN TACTICAL AIRCRAFT

DENNIS J. FOLDS and RODERICK A. BEARD (Georgia Institute of Technology, Atlanta) IN: Human Factors Society, Annual Meeting, 32nd, Anaheim, CA, Oct. 24-28, 1988, Proceedings. Volume 1. Santa Monica, CA, Human Factors Society, 1988, p. 63-67. refs

(Contract F33615-83-D-0601)

Results are presented from a survey of 135 active tactical aircrews regarding use of synthetic voice messages in tactical aircraft. The sample was primarily composed of F-16, F-15, and F-4 pilots. The participants rated 69 existing, proposed, or suggested functions for voice messages in tactical aircraft. Over two-thirds of the participants rated the following functions favorably: Engine Fire, Fuel Low, Oil Pressure, Hydraulic Pressure, Brakes Malfunction, Landing Gear Malfunction, Gear/Flaps Configuration, Low Altitude, Missile Launch, Threat Display, Bingo Fuel, and Joker Fuel. Other functions, applicable to some but not all tactical aircraft, received strong support from the aircrews of the applicable aircraft. The participants' responses to open-ended questions, concerning use of voice messages for checklists and desirable control features for voice message systems, are also summarized. Author

A89-31614

EFFECTIVENESS OF THREE-DIMENSIONAL AUDITORY DIRECTIONAL CUES

GLORIA L. CALHOUN, GERMAN VALENCIA (USAF, Aerospace Medical Research Laboratory, Wright-Patterson AFB, OH), and WILLIAM P. JANSON (Systems Research Laboratories, Inc., Dayton, OH) IN: Human Factors Society, Annual Meeting, 32nd, Anaheim, CA, Oct. 24-28, 1988, Proceedings. Volume 1. Santa Monica, CA, Human Factors Society, 1988, p. 68-72. refs

(Contract F33615-85-C-0541; F33615-87-C-0534)

Natural aural directional cueing in the cockpit should relieve the demands placed on the visual modality, reduce display clutter and alleviate cognitive attention needed to process and extract meaning from coded formats. This experiment compared the effectiveness of three-dimensional (3-D) auditory cues to conventional visual and auditory methods of directing visual attention to peripheral targets. Five directional cues were evaluated: visual symbol, coded aural tone, speech cue, 3-D tone (white noise appearing to emanate from peripheral locations) and 3-D speech (speech cue appearing to emanate from peripheral locations). The results showed significant performance differences as a function of directional cue type in peripheral target task completion time, as well as eye and head reaction time. Results, such as these, will help improve the application of directional sound in operational cockpits. Author

A89-31617* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

VIRTUAL INTERFACE ENVIRONMENT WORKSTATIONS

S. S. FISHER, E. M. WENZEL, C. COLER, and M. W. MCGREEVY (NASA, Ames Research Center, Moffett Field, CA) IN: Human Factors Society, Annual Meeting, 32nd, Anaheim, CA, Oct. 24-28, 1988, Proceedings. Volume 1. Santa Monica, CA, Human Factors Society, 1988, p. 91-95.

A head-mounted, wide-angle, stereoscopic display system controlled by operator position, voice and gesture has been developed at NASA's Ames Research Center for use as a multipurpose interface environment. This Virtual Interface Environment Workstation (VIEW) system provides a multisensory, interactive display environment in which a user can virtually explore a 360-degree synthesized or remotely sensed environment and can viscerally interact with its components. Primary applications of the system are in telerobotics, management of large-scale integrated information systems, and human factors research. System configuration, research scenarios, and research directions are described. Author

A89-31618

DESIGN AND EVALUATION FOR SITUATION AWARENESS ENHANCEMENT

MICA R. ENDSLEY (Northrop Corp., Aircraft Div., Hawthorne, CA) IN: Human Factors Society, Annual Meeting, 32nd, Anaheim, CA, Oct. 24-28, 1988, Proceedings. Volume 1. Santa Monica, CA, Human Factors Society, 1988, p. 97-101. refs

Topics related to situation awareness are reviewed. Various studies to define situation awareness are considered, and a definition is presented. Issues important in designing pilot-vehicle interfaces for maximum situation awareness are examined. Also,

the Situation Awareness Global Assessment Technique (Endsley, 1988) for evaluating the effect of a system design on a pilot's situation awareness is discussed. R.B.

A89-31623
DETERMINATION OF A GAIN-FUNCTION RELATING CONTROL FORCE TO CURSOR VELOCITY
STEPHEN RAUCH (Grumman Corp., Aircraft Systems Div., Bethpage, NY) IN: Human Factors Society, Annual Meeting, 32nd, Anaheim, CA, Oct. 24-28, 1988, Proceedings. Volume 1. Santa Monica, CA, Human Factors Society, 1988, p. 121-125.

F-14D fighter pilots will have the capability to use cursor control to designate symbols and pushbutton legends on multifunction displays (MFD). Since operators often will be required to slew and designate a target symbol or pushbutton legend in diverse environments, it is important to determine a control system gain, the relationship between response magnitude (in this case, force) and amount of cursor movement or velocity, that will enhance performance during slewing/designate tasks. The purpose of this study was to evaluate six different gain-functions analyzing speed, accuracy, and subjective comments, to determine an optimal gain-function relating control force to cursor velocity. Trend indicated that Gain-function 1, the gain-function with the lowest mean pixel error and fastest mean acquisition time, would be the best gain-function to use in the F-14D aircraft. Author

A89-31640
HUMAN-COMPUTER INTERACTION - ANALYSES OF INDIVIDUAL DIFFERENCES AND DECISION-MAKING
ANITA KAK AMBARDAR (Northeastern Illinois University, Chicago, IL) IN: Human Factors Society, Annual Meeting, 32nd, Anaheim, CA, Oct. 24-28, 1988, Proceedings. Volume 2. Santa Monica, CA, Human Factors Society, 1988, p. 826-830. refs

Cognitive differences among individuals significantly influence many aspects of traditional problem-solving performance. A test is presently conducted of the hypothesis that individual differences in various dimensions interact with features of human-computer interfaces. By taking such interactions into account, these interfaces can be optimized to serve user populations of differing cognitive styles. It is found that field-dependent subjects used single-function commands more frequently than field-independent subjects; it is clear that the latter prefer situations to which they can impart their own preferred structure, with greater context-manipulation and control. O.C.

A89-31643* Essex Corp., Orlando, FL.
A DIFFERENTIAL APPROACH TO MICROCOMPUTER TEST BATTERY DEVELOPMENT AND IMPLEMENTATION
R. S. KENNEDY, D. R. BALTZLEY, M. K. OSTEEN, and J. J. TURNAGE (Essex Corp., Orlando, FL) IN: Human Factors Society, Annual Meeting, 32nd, Anaheim, CA, Oct. 24-28, 1988, Proceedings. Volume 2. Santa Monica, CA, Human Factors Society, 1988, p. 838-842. refs
(Contract NAS9-17326; NSF ISI-85-21282)

The present microcomputer-based performance test battery emphasizes psychometric theory and utility for repeated-measures applications during extended exposure to various environmental stressors. In the menu that has been defined at the current state of this system's development, there are more than 30 'qualified' mental tests which stabilize in less than 10 min and possess test-retest reliabilities greater than 0.7 for a three-minute test/work period. The battery encompasses tests of cognition, information processing, psychomotor skill, memory, mood, etc. Several of the tests have demonstrated sensitivity to chemoradiotherapy, sleep loss, hypoxia, amphetamines, thermal stress, sensory deprivation, altitude, fatigue, and alcohol use. Recommendations are presented for 6-, 12-, and 22-min batteries. O.C.

A89-31654
CAPTURING AIR TRAFFIC CONTROLLER EXPERTISE FOR INCORPORATION IN AUTOMATED AIR TRAFFIC CONTROL SYSTEMS
HOWARD L. BREGMAN, WARREN L. MCCABE, and WILLIAM G. SUTCLIFFE (Mitre Corp., McLean, VA) IN: Human Factors Society, Annual Meeting, 32nd, Anaheim, CA, Oct. 24-28, 1988, Proceedings. Volume 2. Santa Monica, CA, Human Factors Society, 1988, p. 1031-1035. Research sponsored by FAA. refs

Under FAA sponsorship an expert system to support air traffic control is being designed. The formal and informal rules used in maintaining flight safety and efficiency are considered. This paper documents the approach to working with air traffic control experts, the results of using that approach, and a distillation of lessons learned. Author

A89-31655
ARTIFICIAL INTELLIGENCE (AI) SYSTEM INTERFACE ATTRIBUTES - SURVEY AND ANALYSES
DENISE L. WILSON, GILBERT G. KUPERMAN (USAF, Aerospace Medical Research Laboratory, Wright-Patterson AFB, OH), ROBYN L. CRAWFORD, and WILLIAM A. PEREZ (Systems Research Laboratories, Inc., Dayton, OH) IN: Human Factors Society, Annual Meeting, 32nd, Anaheim, CA, Oct. 24-28, 1988, Proceedings. Volume 2. Santa Monica, CA, Human Factors Society, 1988, p. 1036-1040. refs

An account is given of the methodology and results of a study which queried AI systems developers as to the relative desirability of 17 AI interface attributes in (1) general applications, (2) a bomber-aircraft crew system, (3) a command-and-control station, and (4) an intelligence-analysis system. While attributes associated with AI communication and education received the lowest ratings, attributes pertaining to the commission of tasks imposing high time-stress levels on crews and other human operators of the interface received the highest ratings. These ratings data were subjected to multidimensional scaling analyses to ascertain which tasks were primarily performed by the AI system, and which required human-AI system communication, as well as which system attributes principally require algorithmic interpretation versus those calling for AI resources. O.C.

A89-31656
A MILITARIZED SYSTEM WITH COMPLETE CONTROL EXERCISED WITHOUT HARDWARE SWITCHES
MICHAEL MAHER (Westinghouse Electric Corp., Baltimore, MD) IN: Human Factors Society, Annual Meeting, 32nd, Anaheim, CA, Oct. 24-28, 1988, Proceedings. Volume 2. Santa Monica, CA, Human Factors Society, 1988, p. 1085-1089.

This paper describes the Man-Machine Interface for a militarized radar system. The interface strives to achieve high reliability in terms of both hardware and operator performance, and allows a single operator the ability to control all aspects of the radar system. To accomplish this, a computer controlled touch input design has been assembled, is being tested, and can be fielded in the early 1990s. Reduction in operator fatigue and increases in operator proficiency are combined with the capabilities to minimize required training time and money, provide a system capable of cost effective updates and growth along with the ability for rapid, real time reconfiguration due to failed electronics or changing battlefield conditions. Author

A89-31657
HUMAN FACTORS IN THE SPACE AND NAVAL WARFARE COMMAND - DISPLAY SYSTEM STANDARDIZATION
PHILLIP J. ANDREWS (U.S. Navy, Space and Naval Warfare Systems Command, Washington, DC), THOMAS B. MALONE, KATHRYN E. PERMENTER, and DAVID R. EIKE (Carlow Associates, Inc., Fairfax, VA) IN: Human Factors Society, Annual Meeting, 32nd, Anaheim, CA, Oct. 24-28, 1988, Proceedings. Volume 2. Santa Monica, CA, Human Factors Society, 1988, p. 1090-1094.

This paper describes the state and status of human factors within the Space and Naval Warfare Command (SPAWAR) by focusing on a major effort currently being pursued within SPAWAR to develop a standard workstation design concept for Navy applications. Human factors concerns were paramount in the assessment of requirements; the major human factors concern was display usability. Author

A89-31663
TEST AND EVALUATION OF AN AIR FORCE NON-DEVELOPMENTAL ITEM (NDI) COMPUTER SYSTEM
ROBERT SIMON, MARTHA A. SCHMIDT, and NANCY COURVILLE (Dynamics Research Corp., Wilmington, MA) IN: Human Factors Society, Annual Meeting, 32nd, Anaheim, CA, Oct. 24-28, 1988, Proceedings. Volume 2. Santa Monica, CA, Human Factors Society, 1988, p. 1162-1165.
(Contract F19628-86-D-0006)

The Air Force is fielding a computer-based command and control system to support fighter base mission requirements. The acquisition strategy for this system was to purchase it as a Non-Developmental Item (NDI). Since the hardware and software were in the Air Force inventory, it was determined that system development was not necessary. Initial implementation and installation occurred without system-level specifications or performance requirements. This paper presents the results of a Human Factors Engineering evaluation of the system from three perspectives: an Expert's view, a Military Standard view, and a User's view. Two primary lessons resulted from the evaluation: First, the multi-perspective evaluation technique is valuable and highly recommended for use in other HFE evaluations. Second, the purchase of NDI or commercial off-the-shelf (COTS) items should be viewed from the systems perspective, i.e., even though subsystems may be NDI, the system may be developmental. Author

A89-31670
PROXIMITY COMPATIBILITY AND THE OBJECT DISPLAY
CHRISTOPHER D. WICKENS and ANTHONY D. ANDRE (Illinois, University, Savoy) IN: Human Factors Society, Annual Meeting, 32nd, Anaheim, CA, Oct. 24-28, 1988, Proceedings. Volume 2. Santa Monica, CA, Human Factors Society, 1988, p. 1335-1339. refs
(Contract DAAA15-86-K-0013)

The fundamental theoretical and applied principles used to justify object display advantages are reviewed, and modifications are suggested. Particular attention is given to the compatibility-of-proximity principle, which asserts that object displays will facilitate information integration but disrupt focused attention on the individual dimensions of the object. A discrimination is made between homogeneous and heterogeneous feature objects, suggesting that only the former will produce emergent features that can facilitate information integration. An experiment is described in which the object display is designed to incorporate an emergent feature that will support the perception of aircraft stall conditions. Evaluation of the display reveals superior integration performance to a separate bar-graph display, but degraded focused attention performance, thus illustrating the principle of proximity of compatibility. Author

A89-31671
THE INTERACTION OF SPATIAL AND COLOR PROXIMITY IN AIRCRAFT STABILITY INFORMATION DISPLAYS
ANTHONY D. ANDRE and CHRISTOPHER D. WICKENS (Illinois, University, Savoy) IN: Human Factors Society, Annual Meeting, 32nd, Anaheim, CA, Oct. 24-28, 1988, Proceedings. Volume 2. Santa Monica, CA, Human Factors Society, 1988, p. 1371-1375. refs
(Contract DAAA15-86-K-0013)

The objective of a complex display design is to provide information in a way that maximizes the user's ability to process that information. This paper explores the effects of manipulating the spatial and color proximity among information displays relevant to aircraft stability during both integration and focused attention tasks. The principle of compatibility of proximity (Wickens, 1987) suggests that tasks requiring the operator to integrate multiple sources of information are better served by close display proximity while tasks that require focused attention on specific sources of are better served by more separate displays. Color proximity results clearly supported this principle and showed that using a common color (i.e., close proximity) to code different information sources facilitated integration performance while using separate colors to code different information sources facilitated focused attention performance. However, close spatial proximity did not foster integration. Instead, distant spatial proximity yielded superior performance for both focused attention and integration tasks. Author

A89-31672
RAPID COMMUNICATION DISPLAY TECHNOLOGY EFFICIENCY IN A MULTI-TASK ENVIRONMENT
SARAH SWIERENGA OSGOOD, REBECCA S. DONOVAN (Systems Research Laboratories, Inc., Dayton, OH), and KENNETH R. BOFF (USAF, Aerospace Medical Research Laboratory, Wright-Patterson AFB, OH) IN: Human Factors Society, Annual Meeting, 32nd, Anaheim, CA, Oct. 24-28, 1988, Proceedings. Volume 2. Santa Monica, CA, Human Factors Society, 1988, p. 1395-1399.
(Contract F33615-85-C-0541)

The present study examined the advantage of rapid communication (RAP-COM) display technology over conventional spatially arrayed displays in the context of secondary task demands. This research represents an early step in assessing the use of RAP-COM display techniques in multi-task environments. Eight subjects were instructed to respond to briefly presented visual stimuli, while concurrently performing an unstable tracking task at two levels of difficulty. Duration thresholds, obtained using a moment-to-moment adaptive tracking performance procedure, were collected for RAP-COM and spatially arrayed displays while RMS error scores were collected from the ynstwble tracking task performance. Information transfer rates for the RAP-COM technique were faster than for the spatially distributed array under both the single and dual task conditions. Regardless of secondary tracking task difficulty, subjects were able to maintain primary task performance levels on RAP-COM and spatial display tasks, although a decrement in tracking performance was seen. Author

A89-31675
LATENCIES OF THE EYE AND HEAD TO TARGETS IN THE VERTICAL AND HORIZONTAL PLANES
WILLIAM P. JANSON (Systems Research Laboratories, Inc., Dayton, OH) and GLORIA L. CALHOUN (USAF, Aerospace Medical Research Laboratory, Wright-Patterson AFB, OH) IN: Human Factors Society, Annual Meeting, 32nd, Anaheim, CA, Oct. 24-28, 1988, Proceedings. Volume 2. Santa Monica, CA, Human Factors Society, 1988, p. 1424-1428. refs
(Contract F33615-85-C-0541)

Past studies involving oculomotor responses have typically been limited to refixations along the horizontal plane, small sample sizes, and little data pertaining to head movement. The study reported herein addresses these data voids by collecting both eye and head latency data for refixations in the horizontal and vertical planes. The subjects' task was to perform a central manual tracking task while periodically responding to a verbal command to classify a target on one of four peripheral monitors. Two targets were displayed along the horizontal plane and two along the vertical plane. Results from 620 trials indicated similar trends for the eye and head latency across all four monitor locations, suggesting no significant differences in eye or head latency as a function of target plane. Author

A89-31676
USING TARGET REPLACEMENT PERFORMANCE TO MEASURE SPATIAL AWARENESS IN A HELMET-MOUNTED SIMULATOR
MAXWELL J. WELLS, ROBERT K. OSGOOD (Systems Research Laboratories, Inc., Dayton, OH), and MICHAEL VENTURINO (USAF, Aerospace Medical Research Laboratory, Wright-Patterson AFB, OH) IN: Human Factors Society, Annual Meeting, 32nd, Anaheim, CA, Oct. 24-28, 1988, Proceedings. Volume 2. Santa Monica, CA, Human Factors Society, 1988, p. 1429-1433. refs
(Contract F33615-85-C-0541)

Measurements were made of the ability of 20 subjects to acquire 3, 6, or 9 stationary visual targets and then replace them after they had been removed. The targets were viewed with various

France ESA Jun. 1988 225 p Prepared in cooperation with Matra Espace, Paris-Velizy, France, Sener S.A., Madrid, Spain, and McDonnell Douglas, Long Beach, CA
(Contract ESA-7324/87-NL-MA(SC))
(BAE-TP-9035; ESA-CR(P)-2676; ETN-89-93930) Avail: NTIS HC A10/MF A01

A European extravehicular activity (EVA) system baseline similar to the STS baseline was derived from analysis of Hermes/Columbus and other ESA manned missions. The ESA suit, however, uses single walled laminate materials. Equipment heat dissipations are collected via cold plates. The sublimator is augmented by a heat storage unit. Primary oxygen storage uses a high pressure nonrechargeable system. The prime mover consists of a separate axial fan, paristaltic pump, and high speed rotary separator. The EVA information/communication module (EICM) uses a digital communications system. The EICM offers a more sophisticated automatic checkout and data display capability than the STS system. The technology assessment indicates that the development of the defined European EVA system lies within the capabilities of European industry although potentially technology transfer from the USA could have substantial benefits. ESA

N89-19807*# Texas Univ., Austin. Lunar Operations Co.
A BOOTSTRAP LUNAR BASE: PRELIMINARY DESIGN REVIEW 2 Final Report
25 Nov. 1987 180 p
(Contract NGT-21-002-080)
(NASA-CR-184753; NAS 1.26:184753) Avail: NTIS HC A09/MF A01 CSCL

A bootstrap lunar base is the gateway to manned solar system exploration and requires new ideas and new designs on the cutting edge of technology. A preliminary design for a Bootstrap Lunar Base, the second provided by this contractor, is presented. An overview of the work completed is discussed as well as the technical, management, and cost strategies to complete the program requirements. The lunar base design stresses the transforming capabilities of its lander vehicles to aid in base construction. The design also emphasizes modularity and expandability in the base configuration to support the long-term goals of scientific research and profitable lunar resource exploitation. To successfully construct, develop, and inhabit a permanent lunar base, however, several technological advancements must first be realized. Some of these technological advancements are also discussed. Author

N89-19808*# Prairie View Agricultural and Mechanical Coll., TX. Coll. of Engineering.
DESIGN OF A SURFACE-BASED FACTORY FOR THE PRODUCTION OF LIFE SUPPORT AND TECHNOLOGY SUPPORT PRODUCTS. PHASE 2: INTEGRATED WATER SYSTEM FOR A SPACE COLONY Preliminary Final Report
1989 114 p
(Contract NGT-21-002-080)
(NASA-CR-184730; NAS 1.26:184730) Avail: NTIS HC A06/MF A01 CSCL 06K

Phase 2 of a conceptual design of an integrated water treatment system to support a space colony is presented. This includes a breathable air manufacturing system, a means of drilling for underground water, and storage of water for future use. The system is to supply quality water for biological consumption, farming, residential and industrial use and the water source is assumed to be artesian or subsurface and on Mars. Design criteria and major assumptions are itemized. A general block diagram of the expected treatment system is provided. The design capacity of the system is discussed, including a summary of potential users and the level of treatment required; and, finally, various treatment technologies are described. Author

N89-19809*# Essex Corp., Huntsville, AL.
ADVANCED EXTRAVEHICULAR ACTIVITY SYSTEMS REQUIREMENTS DEFINITION STUDY. PHASE 2: EXTRAVEHICULAR ACTIVITY AT A LUNAR BASE Final Report
VALERIE NEAL, NICHOLAS SHIELDS, JR., GERALD P. CARR, WILLIAM POGUE, HARRISON H. SCHMITT, and ARTHUR E. SCHULZE (Lovelace Scientific Resources, Inc., Albuquerque, NM.) Sep. 1988 160 p
(Contract NAS9-17779)
(NASA-CR-172117; NAS 1.26:172117) Avail: NTIS HC A08/MF A01 CSCL 06K

The focus is on Extravehicular Activity (EVA) systems requirements definition for an advanced space mission: remote-from-main base EVA on the Moon. The lunar environment, biomedical considerations, appropriate hardware design criteria, hardware and interface requirements, and key technical issues for advanced lunar EVA were examined. Six remote EVA scenarios (three nominal operations and three contingency situations) were developed in considerable detail. B.G.

N89-19810# Aeronautical Research Labs., Melbourne (Australia).
THERMAL STRESS IN RAN SEA KING HELICOPTER OPERATIONS
J. G. MANTON and K. C. HENDY Feb. 1988 50 p
(ARL-SYS-R-40; AR-004-592) Avail: NTIS HC A03/MF A01

Thermal stress in aircrew operating in the cabin and cockpit environment of the RAN's Sea King helicopter was examined. The high thermal loads experienced in the helicopter have previously been established and various options for ameliorating the conditions have also been proposed. A review of the literature on thermal stress research is presented. The development of an Index of Thermal Stress for the Sea King (SKITS) is reported along with the results of a study to determine the ameliorating effect of blown cooled air directed at the faces of subjects in a thermal chamber. Author

N89-19811# Army Natick Research and Development Command, MA.
COOLING EFFECTIVENESS OF A HYBRID MICROCLIMATE GARMENT Final Report, Jul. - Aug. 1987
BARRY S. DECRISTOFANO, JOSEPH S. COHEN, BRUCE S. CADARETTE, and KAREN L. SPECKMAN Apr. 1988 22 p
(AD-A201115; NATICK-TR-88/003) Avail: NTIS HC A03/MF A01 CSCL 05H

A prototype microclimate cooling garment that would allow the wearer to connect to either an air or a liquid cooling unit was tested and compared with existing air and liquid vests. Five male soldiers wore the three garments (hybrid, air, and liquid) on different days while walking on a treadmill in a climatically controlled environment. The chamber conditions were: dry bulb temperature, 38C (100F); relative humidity, 20 percent. The exercise generated a 332-W metabolic rate. The average metabolic rate (including rest periods) was 287 W. The hybrid garment, in either mode, performed as well as the individual air and liquid garments. Though the hybrid vest succeeded physiologically, comfort and fit problems were revealed that will require major changes in the next iteration. GRA

N89-19812# Anthropology Research Project, Yellow Springs, OH.
COMPUTER SOFTWARE USED IN US ARMY ANTHROPOMETRIC SURVEY 1987-1988 Final Report, Sep. 1986 - Mar. 1988
THOMAS D. CHURCHILL, BRUCE BRADTMILLER, and CLAIRE C. GORDON 30 Jun. 1988 120 p
(Contract DAAK60-86-C-0128)
(AD-A201185; NATICK-TR-88/045) Avail: NTIS HC A06/MF A01 CSCL 05I

This report describes the hardware and software used in the 1987 to 1988 anthropometric survey of the U.S. Army. It includes a background section outlining how anthropometric data can be edited mathematically, and how such editing has been done in surveys of the past. It then describes the data entry and editing software which was created especially for the 1987 to 1988 survey, and how that software is based on historically proven techniques. Programs which randomly select subjects for measurement from

among those who are screened and which calculate inter-observer measurement error are also described. The appendices include a self-contained hardware/software user's guide, and complete program listings for all software used in the survey. GRA

N89-19813# Anthropology Research Project, Yellow Springs, OH.
THE DEVELOPMENT AND VALIDATION OF AN AUTOMATED HEADBOARD DEVICE FOR MEASUREMENT OF THREE-DIMENSIONAL COORDINATES OF THE HEAD AND FACE Final Report, Sep. 1986 - Dec. 1987
JAMES F. ANNIS and CLAIRE C. GORDON 1 Jun. 1988 198 p
(Contract DAAK60-86-C-0128)
(AD-A201186; NATICK-TR-88/048) Avail: NTIS HC A09/MF A01 CSCL 05I

The measurement of three-dimensional (3-D) coordinates of the surface of the human body finds its justification in the applicability of such anthropometric information to the design of personal protective items for the head and face where good fit is critical. In the future, anthropologists and engineers will utilize remote imaging devices, such as lasers, video cameras, and holographic systems, to collect great quantities of 3-D shape information very rapidly. The measurement accuracy of such devices as well as the statistical means for analyzing large-sample data are still under investigation, however. For the present, we must be satisfied with 3-D information on a relatively low number of body landmark locations, particularly when measured on large samples under field survey conditions. The area of the body for which the collection of 3-D information in a major anthropometric survey seems most warranted is the head and face. GRA

N89-19814# Naval Postgraduate School, Monterey, CA.
THE EFFECTS OF A PITCHED FIELD ORIENTATION ON HAND/EYE COORDINATION M.S. Thesis
CYNTHIA J. BALLINGER Sep. 1988 70 p
(AD-A201620) Avail: NTIS HC A04/MF A01 CSCL 06D

Ten subjects judged eye level by making verbal and pointing responses while looking into a box that was pitched at angles of approximately -15, -7.5, 0, 7.5 and 15 and 15 degrees. The mean verbal judgement changed as a function of the box's pitch angle according to the relationship: Judged Eye Level = 0.48 (Box Pitch Angle) - 0.31 Degrees which agrees with the results of previous studies. The mean pointing responses were also a function of the box's pitch angle: Pointing Response = -0.19 (Box Pitch Angle) - 5.39 Degrees Thus, the mean pointing responses change at approximately 40 percent of the rate of the perceptual responses, as indicated by the verbal judgements, and are in the opposite direction. These errors have implications for the design of displays and controls for vehicles that operate in environments where pitched visual fields are encountered. GRA

N89-19815# Naval Postgraduate School, Monterey, CA.
DEVELOPMENT OF A MODEL WHICH PROVIDES A TOTAL SYSTEM APPROACH TO INTEGRATING VOICE RECOGNITION AND SPEECH SYNTHESIS INTO THE COCKPIT OF US NAVY AIRCRAFT M.S. Thesis
MARGARET A. LEE Sep. 1988 65 p
(AD-A202122; AD-E501048) Avail: NTIS HC A04/MF A01 CSCL 01D

Pilot workload saturation in the cockpit of U.S. Navy Aircraft has become a serious concern. Literature, studies, and flight tests indicate that utilizing a voice interactive system for certain cockpit tasks can reduce this workload by decreasing the time required to perform the task. This being the case, the problem which remains is one of deciding which tasks to convert. Therefore, a model has been developed which provides the designer with a total systems approach for use in deciding what combination of tasks, which if converted for performance by the voice interactive system, will result in the greatest workload reduction without overloading the pilot's voice channels. GRA

N89-19816# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (Germany, F.R.).
STUDY ON CHECKOUT OF FLIGHT UNITS AND SUBSYSTEMS Final Report
W. BERGHOFER and S. Y. OVADYA Paris, France ESA Jun. 1988 130 p
(Contract ESA-5974/84)
(ESA-CR(P)-2693; ETN-89-93937) Avail: NTIS HC A07/MF A01

Tradeoffs were performed to derive the ground support requirements of TV-SAT. The interfaces between checkout equipment, onboard data handling, and test facilities were defined. The European Test Operation Langage and AS-BASIC were compared in terms of utilization, support, and performance. Remote checkout for extravehicular activity (EVA) was studied. It is shown that it is not possible to perform EVA without local monitoring, control of the acquired data and their transmission. Thus, as a windfall product remote checkout becomes available for the whole life of the EVA space suit system, and should be used to reduce cost and improve efficiency of the whole system. ESA

N89-19846*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
PHYSIOLOGICAL ASSESSMENT OF TASK UNDERLOAD
J. RAYMOND COMSTOCK, JR., RANDALL L. HARRIS, SR., and ALAN T. POPE *In* NASA. Lyndon B. Johnson Space Center, 2nd Annual Workshop on Space Operations Automation and Robotics (SOAR 1988) p 221-226 Nov. 1988
Avail: NTIS HC A22/MF A01 CSCL 05H

The ultimate goal of research efforts directed at underload, boredom, or complacency in high-technology work environments is to detect conditions or states of the operator that can be demonstrated to lead to performance degradation, and then to intervene in the environment to restore acceptable system performance. Physiological measures may provide indices of changes in condition or state of the operator that may be of value in high-technology work environments. The focus of the present study was on the use of physiological measures in the assessment of operator condition or state in a task underload scenario. A fault acknowledgement task characterized by simple repetitive responses with minimal novelty, complexity, and uncertainty was employed to place subjects in a task underload situation. Physiological measures (electrocardiogram (ECG), electroencephalogram (EEG), and pupil diameter) were monitored during task performance over a one-hour test session for 12 subjects. Each of the physiological measures exhibited changes over the test session indicative of decrements in subject arousal level. While high correlations between physiological measures were found across subjects, individual differences between subjects support the use of profiling techniques to establish baselines unique to each subject. Author

N89-19847*# Aerospace Medical Research Labs., Wright-Patterson AFB, OH. Human Engineering Lab.
A SCHEMA-BASED MODEL OF SITUATION AWARENESS: IMPLICATIONS FOR MEASURING SITUATION AWARENESS
MARTIN L. FRACKER *In* NASA. Lyndon B. Johnson Space Center, 2nd Annual Workshop on Space Operations Automation and Robotics (SOAR 1988) p 227-231 Nov. 1988
Avail: NTIS HC A22/MF A01 CSCL 05H

Measures of pilot situation awareness (SA) are needed in order to know whether new concepts in display design help pilots keep track of rapidly changing tactical situations. In order to measure SA, a theory of situation assessment is needed. Such a theory is summarized, encompassing both a definition of SA and a model of situation assessment. SA is defined as the pilot's knowledge about a zone of interest at a given level of abstraction. Pilots develop this knowledge by sampling data from the environment and matching the sampled data to knowledge structures stored in long-term memory. Matched knowledge structures then provide the pilot's assessment of the situation and serve to guide his attention. A number of cognitive biases that result from the knowledge matching process are discussed,

as are implications for partial report measures of situation awareness. Author

N89-19860*# Essex Corp., Orlando, FL.
OPTIMAL SOLUTIONS FOR COMPLEX DESIGN PROBLEMS: USING ISOPERFORMANCE SOFTWARE FOR HUMAN FACTORS TRADE OFFS
ROBERT S. KENNEDY, MARSHALL B. JONES (Pennsylvania State Univ., Hershey.), and DENNIS R. BALTZLEY *In* NASA. Lyndon B. Johnson Space Center, 2nd Annual Workshop on Space Operations Automation and Robotics (SOAR 1988) p 313-319 Nov. 1988
Avail: NTIS HC A22/MF A01 CSCL 05H

A major application of isoperformance is as a trade-off methodology of the three major drivers of system design; equipment, training variables, and user characteristics. The flexibility of isoperformance allows each of these three components to be nearly any rational variation. For example, aptitude may be military Armed Forces Qualification Testing (AFQT) categories, cutoff scores within a selection procedure, or simply dichotomizing high and low scorers (pass/fail). Equipment may be new versus old, 'smart' versus dumb, high versus low resolution, etc. Training may be short versus long or varieties of media types (lecture versus CAI/CBI versus self-paced workbooks). In its final computerized form isoperformance lets the user set an operational level of performance (e.g., a jet pilot in a simulated emergency must take prescribed corrective action and clear the plane in several seconds, pilot astronauts will check out all shuttle flight systems within 30 minutes, or Mission Specialists must handle sucdessfully a required number of job elements). At this point the computer program guides the user through any requested trade-offs of the three components while maintaining the specified operational level of performance through isoperformance curves. A demonstration of the computer program is currently available. Author

N89-19861*# Lockheed Engineering and Sciences Co., Houston, TX.
SIMULATION OF THE HUMAN-TELEROBOT INTERFACE
MARK A. STUART and RANDY L. SMITH *In* NASA. Lyndon B. Johnson Space Center, 2nd Annual Workshop on Space Operations Automation and Robotics (SOAR 1988) p 321-326 Nov. 1988 (Contract NAS9-17900)
Avail: NTIS HC A22/MF A01 CSCL 05H

A part of NASA's Space Station will be a Flight Telerobotic Servicer (FTS) used to help assemble, service, and maintain the Space Station. Since the human operator will be required to control the FTS, the design of the human-telerobot interface must be optimized from a human factors perspective. Simulation has been used as an aid in the development of complex systems. Simulation has been especially useful when it has been applied to the development of complex systems. Simulation should ensure that the hardware and software components of the human-telerobot interface have been designed and selected so that the operator's capabilities and limitations have been accommodated for since this is a complex system where few direct comparisons to existent systems can be made. Three broad areas of the human-telerobot interface where simulation can be of assistance are described. The use of simulation not only can result in a well-designed human-telerobot interface, but also can be used to ensure that components have been selected to best meet system's goals, and for operator training. Author

N89-19862*# CAMUS, Inc., Huntsville, AL.
MAN-SYSTEMS REQUIREMENTS FOR THE CONTROL OF TELEOPERATORS IN SPACE
NICHOLAS L. SHIELDS, JR. *In* NASA. Lyndon B. Johnson Space Center, 2nd Annual Workshop on Space Operations Automation and Robotics (SOAR 1988) p 329-334 Nov. 1988
Avail: NTIS HC A22/MF A01 CSCL 05H

The microgravity of the space environment has profound effects on humans and, consequently, on the design requirements for subsystems and components with which humans interact. There are changes in the anthropometry, vision, the perception of orientation, posture, and the ways in which we exert energy. The design requirements for proper human engineering must reflect each of the changes that results, and this is especially true in the exercise of control over remote and teleoperated systems where the operator is removed from any direct sense of control. The National Aeronautics and Space Administration has recently completed the first NASA-wide human factors standard for microgravity. The Man-Systems Integration Standard, NASA-STD-3000, contains considerable information on the appropriate design criteria for microgravity, and there is information that is useful in the design for teleoperated systems. There is not, however, a dedicated collection of data which pertains directly to the special cases of remote and robotic operations. The design considerations for human-system interaction in the control of remote systems in space are discussed, with brief details on the information to be found in the NASA-STD-3000, and arguments for a dedicated section within the Standard which deals with robotic, teleoperated and remote systems and the design requirements for effective human control of these systems in the space environment, and from the space environment. Author

N89-19863*# West Virginia Univ., Morgantown. Dept. of Mechanical and Aerospace Engineering.
INTEGRATION OF A COMPUTERIZED TWO-FINGER GRIPPER FOR ROBOT WORKSTATION SAFETY
JOHN E. SNECKENBERGER and KAZUKI YOSHIKATA *In* NASA. Lyndon B. Johnson Space Center, 2nd Annual Workshop on Space Operations Automation and Robotics (SOAR 1988) p 335-338 Nov. 1988
Avail: NTIS HC A22/MF A01 CSCL 05H

A microprocessor-based controller has been developed that continuously monitors and adjusts the gripping force applied by a special two-finger gripper. This computerized force sensing gripper system enables the endeffector gripping action to be independently detected and corrected. The gripping force applied to a manipulated object is real-time monitored for problem situations, situations which can occur during both planned and errant robot arm manipulation. When unspecified force conditions occur at the gripper, the gripping force controller initiates specific reactions to cause dynamic corrections to the continuously variable gripping action. The force controller for this intelligent gripper has been interfaced to the controller of an industrial robot. The gripper and robot controllers communicate to accomplish the successful completion of normal gripper operations as well as unexpected hazardous situations. An example of an unexpected gripping condition would be the sudden deformation of the object being manipulated by the robot. The capabilities of the interfaced gripper-robot system to apply workstation safety measures (e.g., stop the robot) when these unexpected gripping effects occur have been assessed. Author

N89-19864*# Michigan Technological Univ., Houghton. Dept. of Mechanical Engineering.
LOCAL POSITION CONTROL: A NEW CONCEPT FOR CONTROL OF MANIPULATORS
FREDERICK A. KELLY *In* NASA. Lyndon B. Johnson Space Center, 2nd Annual Workshop on Space Operations Automation and Robotics (SOAR 1988) p 339-341 Nov. 1988
Avail: NTIS HC A22/MF A01 CSCL 05H

Resolved motion rate control is currently one of the most frequently used methods of manipulator control. It is currently used in the Space Shuttle remote manipulator system (RMS) and in prosthetic devices. Position control is predominately used in locating the end-effector of an industrial manipulator along a path with prescribed timing. In industrial applications, resolved motion rate control is inappropriate since position error accumulates. This is due to velocity being the control variable. In some applications this property is an advantage rather than a disadvantage. It may be more important for motion to end as soon as the input command is removed rather than reduce the position error to zero. Local position control is a new concept for manipulator control which retains the important properties of resolved motion rate control, but reduces the drift. Local position control can be considered to

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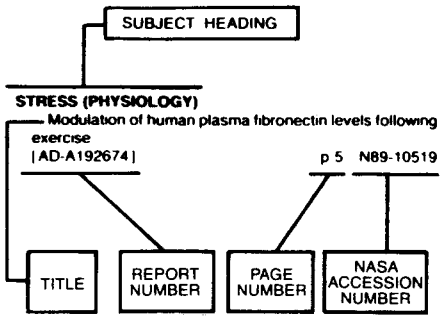

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be a generalization of resolved position and resolved rate control. It places both control schemes on a common mathematical basis. Author

N89-19865*# Cincinnati Univ., OH. Dept. of Mechanical and Industrial Engineering.
DEXTERITY ANALYSIS AND ROBOT HAND DESIGN
LU LI, A. H. SONI, CAI CHUNSHENG, and MAX BROWN *In* NASA. Lyndon B. Johnson Space Center, 2nd Annual Workshop on Space Operations Automation and Robotics (SOAR 1988) p 343-351 Nov. 1988
Avail: NTIS HC A22/MF A01 CSCL 05H

Understanding about a dexterous robot hand's motion ranges is important to the precision grasping and precision manipulation. A planar robot hand is studied for object orientation, including ranges of motion, measures with respect to the palm, position reaching of a point in the grasped object, and rotation of the object about the reference point. The rotational dexterity index and dexterity chart are introduced and an analysis procedure is developed for calculating these quantities. A design procedure for determining the hand kinematic parameters based on a desired partial or complete dexterity chart is also developed. These procedures have been tested in detail for a planar robot hand with two 2- or 3-link fingers. The derived results are shown to be useful to performance evaluation, kinematic parameter design, and grasping motion planning for a planar robot hand. Author

N89-19866*# Central State Univ., Wilberforce, OH. Dept. of Manufacturing Engineering.
CONCEPT FOR A LARGE MASTER/SLAVE-CONTROLLED ROBOTIC HAND
WILLIAM A. GRISSOM, MAHMOUD A. ABDALLAH, and CARL L. WHITE (Computerized Technologies, Inc., Columbus, OH.) *In* NASA. Lyndon B. Johnson Space Center, 2nd Annual Workshop on Space Operations Automation and Robotics (SOAR 1988) p 353-359 Nov. 1988 Sponsored in part by an Ohio Board of Regeants Research Challenge grant
(Contract NAGW-1336; JPL-958292)
Avail: NTIS HC A22/MF A01 CSCL 05H

A strategy is presented for the design and construction of a large master/slave-controlled, five-finger robotic hand. Each of the five fingers will possess four independent axes each driven by a brushless DC servomotor and, thus, four degrees-of-freedom. It is proposed that commercially available components be utilized as much as possible to fabricate a working laboratory model of the device with an anticipated overall length of two-to-four feet (0.6 to 1.2 m). The fingers are to be designed so that proximity, tactile, or force/torque sensors can be imbedded in their structure. In order to provide for the simultaneous control of the twenty independent hand joints, a multilevel master/slave control strategy is proposed in which the operator wears a specially instrumented glove which produces control signals corresponding to the finger configurations and which is capable of conveying sensor feedback signals to the operator. Two dexterous hand master devices are currently commercially available for this application with both undergoing continuing development. A third approach to be investigated for the master control mode is the use of real-time image processing of a specially patterned master glove to provide the respective control signals for positioning the multiple finger joints. Author

N89-19870*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
DESIGN CONCEPT FOR THE FLIGHT TELEROBOTIC SERVICER (FITS)
J. F. ANDARY, S. W. HINKAI, and J. G. WATZIN *In* NASA. Lyndon B. Johnson Space Center, 2nd Annual Workshop on Space Operations Automation and Robotics (SOAR 1988) p 391-396 Nov. 1988
Avail: NTIS HC A22/MF A01 CSCL 05H

NASA has just completed an in-house Phase B Study (one of three studies) for the preliminary definition of a teleoperated robotic device that will be used on the National Space Transportation System (NSTS) and the Space Station to assist the astronauts in the performance of assembly, maintenance, servicing, and inspection tasks. This device, the Flight Telerobotic Servicer (FTS), will become a permanent element on the Space Station. Although it is primarily a teleoperated device, the FTS is being designed to grow and evolve to higher states of autonomy. Eventually, it will be capable of working from the Orbital Maneuvering Vehicle (OMV) to service free-flying spacecraft at great distances from the Space Station. A version of the FTS could also be resident on the large space platforms that are part of the Space Station Program. Author

N89-19871*# Wisconsin Univ., Madison. Coll. of Engineering.
THE WCSAR TELEROBOTICS TEST BED
N. DUFFIE, J. ZIK, R. TEETER, and T. CRABB (Astronautics Corp. of America, Madison, WI.) *In* NASA. Lyndon B. Johnson Space Center, 2nd Annual Workshop on Space Operations Automation and Robotics (SOAR 1988) p 397-402 Nov. 1988
(Contract NAGW-975)
Avail: NTIS HC A22/MF A01 CSCL 05H

Component technologies for use in telerobotic systems for space are being developed. As part of this effort, a test bed was established in which these technologies can be verified and integrated into telerobotic systems. The facility consists of two slave industrial robots, an articulated master arm controller, a cartesian coordinate master arm controller, and a variety of sensors, displays and stimulators for feedback to human operators. The controller of one of the slave robots remains in its commercial state, while the controller of the other robot has been replaced with a new controller that achieves high-performance in telerobotic operating modes. A dexterous slave hand which consists of two fingers and a thumb is being developed, along with a number of force-reflecting and non-force reflecting master hands, wrists and arms. A tactile sensing finger tip based on piezo-film technology has been developed, along with tactile stimulators and CAD-based displays for sensory feedback and sensory substitution. The telerobotics test bed and its component technologies are described, as well as the integration of these component technologies into telerobotic systems, and their performance in conjunction with human operators. Author

N89-19872*# Aerospace Medical Research Labs., Wright-Patterson AFB, OH.
THE USE OF THE ARTICULATED TOTAL BODY MODEL AS A ROBOT DYNAMICS SIMULATION TOOL
LOUISE A. OBERGFELL, XAVIER J. R. AVULA, and INTS KALEGS *In* NASA. Lyndon B. Johnson Space Center, 2nd Annual Workshop on Space Operations Automation and Robotics (SOAR 1988) p 403-409 Nov. 1988
Avail: NTIS HC A22/MF A01 CSCL 05H

The Articulated Total Body (ATB) model is a computer sumulation program which was originally developed for the study of aircrew member dynamics during ejection from high-speed aircraft. This model is totally three-dimensional and is based on the rigid body dynamics of coupled systems which use Euler's equations of motion with constraint relations of the type employed in the Lagrange method. In this paper the use of the ATB model as a robot dynamics simulation tool is discussed and various simulations are demonstrated. For this purpose the ATB model has been modified to allow for the application of torques at the joints as functions of state variables of the system. Specifically, the motion of a robotic arm with six revolute articulations with joint torques prescribed as functions of angular displacement and angular velocity are demonstrated. The simulation procedures developed in this work may serve as valuable tools for analyzing robotic mechanisms, dynamic effects, joint load transmissions, feed-back control algorithms employed in the actuator control and end-effector trajectories. Author

N89-19873*# Martin Marietta Aero and Naval Systems, Baltimore, MD.
TELEPRESENCE AND TELEROBOTICS
JOHN GARIN, JOSEPH MATTEO, and VON AYRE JENNINGS

In NASA. Lyndon B. Johnson Space Center, 2nd Annual Workshop on Space Operations Automation and Robotics (SOAR 1988) p 411-420 Nov. 1988
Avail: NTIS HC A22/MF A01 CSCL 05H

The capability for a single operator to simultaneously control complex remote multi degree of freedom robotic arms and associated dextrous end effectors is being developed. An optimal solution within the realm of current technology, can be achieved by recognizing that: (1) machines/computer systems are more effective than humans when the task is routine and specified, and (2) humans process complex data sets and deal with the unpredictable better than machines. These observations lead naturally to a philosophy in which the human's role becomes a higher level function associated with planning, teaching, initiating, monitoring, and intervening when the machine gets into trouble, while the machine performs the codifiable tasks with deliberate efficiency. This concept forms the basis for the integration of man and telerobotics, i.e., robotics with the operator in the control loop. The concept of integration of the human in the loop and maximizing the feed-forward and feed-back data flow is referred to as telepresence. Author

N89-19874*# Carnegie-Mellon Univ., Pittsburgh, PA. The Robotics Inst.
A NOVEL MANIPULATOR TECHNOLOGY FOR SPACE APPLICATIONS
DONALD SCHMITZ, PRADEEP KHOSIA, and TAKEO KANADE *In* NASA. Lyndon B. Johnson Space Center, 2nd Annual Workshop on Space Operations Automation and Robotics (SOAR 1988) p 421-428 Nov. 1988
Avail: NTIS HC A22/MF A01 CSCL 05H

Modular manipulator designs have long been considered for use as research tools, and as the basis for easily modified industrial manipulators. In these manipulators the links and joints are discrete and modular components that can be assembled into a desired manipulator configuration. As hardware advances have made actual modular manipulators practical, various capabilities of such manipulators have gained interest. Particularly desirable is the ability to rapidly reconfigure such a manipulator, in order to custom tailor it to specific tasks. The reconfiguration greatly enhances the capability of a given amount of manipulator hardware. The development of a prototype modular manipulator is discussed as well as the implementation of a configuration independent manipulator kinematics algorithm used for path planning in the prototype. Author

N89-19875*# Carnegie-Mellon Univ., Pittsburgh, PA. Robotics Inst.
A ROBUST CONTROL SCHEME FOR FLEXIBLE ARMS WITH FRICTION IN THE JOINTS
KULDIP S. RATTAN, VICENTE FELIU (Universidad Nacional de Educacion a Distancia, Madrid, Spain), and H. BENJAMIN BROWN, JR. *In* NASA. Lyndon B. Johnson Space Center, 2nd Annual Workshop on Space Operations Automation and Robotics (SOAR 1988) p 429-435 Nov. 1988
Avail: NTIS HC A22/MF A01 CSCL 05H

A general control scheme to control flexible arms with friction in the joints is proposed in this paper. This scheme presents the advantage of being robust in the sense that it minimizes the effects of the Coulomb friction existing in the motor and the effects of changes in the dynamic friction coefficient. A justification of the robustness properties of the scheme is given in terms of the sensitivity analysis. Author

N89-19876*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
TELEROBOT OPERATOR CONTROL STATION REQUIREMENTS
EDWIN P. KAN *In* NASA. Lyndon B. Johnson Space Center, 2nd Annual Workshop on Space Operations Automation and Robotics (SOAR 1988) p 437-443 Nov. 1988
Avail: NTIS HC A22/MF A01 CSCL 05H

The operator control station of a telerobot system has unique functional and human factors requirements. It has to satisfy the needs of a truly interactive and user-friendly complex system, a telerobot system being a hybrid between a teleoperated and an autonomous system. These functional, hardware and software requirements are discussed, with explicit reference to the design objectives and constraints of the JPL/NASA Telerobot Demonstrator System. Author

N89-19877*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
TIME-DELAYED OPERATION OF A TELEROBOT VIA GEOSYNCHRONOUS RELAY
BRIAN H. WILCOX *In* NASA. Lyndon B. Johnson Space Center, 2nd Annual Workshop on Space Operations Automation and Robotics (SOAR 1988) p 445-447 Nov. 1988
Avail: NTIS HC A22/MF A01 CSCL 05H

Operation of a telerobot is compromised if a time delay of more than a few hundred milliseconds exists between the operator and remote manipulator. However, the most economically attractive way to perform telerobotic functions such as assembly, maintenance, and repair in Earth orbit is via geosynchronous relay satellites to a ground-based operator. This induces loop delays from one-half to two seconds, depending on how many relays are involved. Such large delays makes direct master-slave, force-reflecting teleoperated systems infeasible. Research at JPL on a useful telerobot that operates with such time delays is described. Author

N89-19878*# Texas Instruments, Inc., Dallas. Speech and Image Understanding Lab.
A REPRESENTATIONAL FRAMEWORK AND USER-INTERFACE FOR AN IMAGE UNDERSTANDING WORKSTATION
JOYCE D. SCHROEDER *In* NASA. Lyndon B. Johnson Space Center, 2nd Annual Workshop on Space Operations Automation and Robotics (SOAR 1988) p 451-456 Nov. 1988
Avail: NTIS HC A22/MF A01 CSCL 05H

Problems in image understanding involve a wide variety of data (e.g., image arrays, edge maps, 3-D shape models) and processes or algorithms (e.g., convolution, feature extraction, rendering). The underlying structure of an Image Understanding Workstation designed to support mulitple levels and types of representations for both data and processes is described, also the user-interface. The Image Understanding Workstation consists of two parts: the Image Understanding (IU) Framework, and the user-interface. The IU Framework is the set of data and process representations. It includes multiple levels of representation for data such as images (2-D), sketches (2-D), surfaces (2 1/2 D), and models (3-D). The representation scheme for processes characterizes their inputs, outputs, and parameters. Data and processes may reside on different classes of machines. The user-interface to the IU Workstation gives the user convenient access for creating, manipulating, transforming, and displaying image data. The user-interface follows the structure of the IU Framework and gives the user control over multiple types of data and processes. Both the IU Framework and user-interface are implemented on a LISP machine. Author

N89-19879*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
MACHINE VISION FOR SPACE TELEROBOTICS AND PLANETARY ROVERS
BRIAN H. WILCOX *In* NASA. Lyndon B. Johnson Space Center, 2nd Annual Workshop on Space Operations Automation and Robotics (SOAR 1988) p 457-460 Nov. 1988
Avail: NTIS HC A22/MF A01 CSCL 05H

Machine vision allows a non-contact means of determining the three-dimensional shape of objects in the environment, enabling the control of contact forces when manipulation by a telerobot or traversal by a vehicle is desired. Telerobotic manipulation in Earth orbit requires a system that can recognize known objects in spite of harsh lighting conditions and highly specular or absorptive surfaces. Planetary surface traversal requires a system that can

recognize the surface shape and properties of an unknown and arbitrary terrain. Research on these two rather disparate types of vision systems is described. Author

N89-19880*# Texas Instruments, Inc., Dallas. Speech and Image Understanding Lab.
VOICE CONTROL OF COMPLEX WORKSTATIONS
JEFFREY L. SCRUGGS *In* NASA. Lyndon B. Johnson Space Center, 2nd Annual Workshop on Space Operations Automation and Robotics (SOAR 1988) p 461-466 Nov. 1988
Avail: NTIS HC A22/MF A01 CSCL 05H

The use of a speaker-dependent connected word recognition system to control an Air Traffic Control (ATC) demonstration workstation is described, also the work that went into developing that speech system. The workstation with speech recognition was demonstrated live at an Air Traffic Controller's Association convention in 1987. The purpose of the demonstration workstation is discussed, with the development of the speech interface highlighted. Included are: a brief description of the speech hardware and software, and overview of the speech driven workstation functions, a description of the speech vocabulary/grammer, and details that the enrollment and training procedures used in preparing the controllers for the demonstrations. Although no quantitative results are available, the potential benefits of using voice as an interface to this type of workstation are discussed and limitations of current speech technology and areas where more work is required are highlighted. Author

N89-19881*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
A MULTI-SENSOR SYSTEM FOR ROBOTICS PROXIMITY OPERATIONS
J. B. CHEATHAM, C. K. WU, P. L. WEILAND (Rice Univ., Houston, TX.), and T. F. CLEGHORN *In its* 2nd Annual Workshop on Space Operations Automation and Robotics (SOAR 1988) p 467-470 Nov. 1988
(Contract NCC9-16; NAG9-208)
Avail: NTIS HC A22/MF A01 CSCL 05H

Robots without sensors can perform only simple repetitive tasks and cannot cope with unplanned events. A multi-sensor system is needed for a robot to locate a target, move into its neighborhood and perform operations in contact with the object. Systems that can be used for such tasks are described. Author

N89-19882*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
A METHODOLOGY FOR AUTOMATION AND ROBOTICS EVALUATION APPLIED TO THE SPACE STATION TELEROBOTIC SERVICER
JEFFREY H. SMITH, MAX GYANFI, KENT VOLKMER, and WAYNE ZIMMERMAN *In* NASA. Lyndon B. Johnson Space Center, 2nd Annual Workshop on Space Operations Automation and Robotics (SOAR 1988) p 471-479 Nov. 1988
(Contract NAS7-918)
Avail: NTIS HC A22/MF A01 CSCL 05H

The efforts of a recent study aimed at identifying key issues and trade-offs associated with using a Flight Telerobotic Servicer (FTS) to aid in Space Station assembly-phase tasks is described. The use of automation and robotic (A and R) technologies for large space systems would involve a substitution of automation capabilities for human extravehicular or intravehicular activities (EVA, IVA). A methodology is presented that incorporates assessment of candidate assembly-phase tasks, telerobotic performance capabilities, development costs, and effect of operational constraints (space transportation system (STS), attached payload, and proximity operations). Changes in the region of cost-effectiveness are examined under a variety of systems design assumptions. A discussion of issues is presented with focus on three roles the FTS might serve: (1) as a research-oriented testbed to learn more about space usage of telerobotics; (2) as a research based testbed having an experimental demonstration orientation with limited assembly and servicing applications; or (3) as an operational system to augment EVA and to aid the construction of the Space Station and to reduce the programmatic (schedule) risk by increasing the flexibility of mission operations. Author

N89-19883*# Little (Arthur D.), Inc., Cambridge, MA. Center for Product Development.
SENSING HUMAN HAND MOTIONS FOR CONTROLLING DEXTEROUS ROBOTS
BETH A. MARCUS, PHILIP J. CHURCHILL, and ARTHUR D. LITTLE *In* NASA. Lyndon B. Johnson Space Center, 2nd Annual Workshop on Space Operations Automation and Robotics (SOAR 1988) p 481-485 Nov. 1988
Avail: NTIS HC A22/MF A01 CSCL 05H

The Dexterous Hand Master (DHM) system is designed to control dexterous robot hands such as the UTAH/MIT and Stanford/JPL hands. It is the first commercially available device which makes it possible to accurately and confortably track the complex motion of the human finger joints. The DHM is adaptable to a wide variety of human hand sizes and shapes, throughout their full range of motion. Author

N89-19884*# Westinghouse Electric Corp., Madison, PA. Robotics and Mechanical Design.
APPLICATION OF MODEL BASED CONTROL TO ROBOTIC MANIPULATORS
LYMAN J. PETROSKY and IRVING J. OPPENHEIM (Carnegie-Mellon Univ., Pittsburgh, PA.) *In* NASA. Lyndon B. Johnson Space Center, 2nd Annual Workshop on Space Operations Automation and Robotics (SOAR 1988) p 487-493 Nov. 1988
(Contract DE-AC02-85NE-37947)
Avail: NTIS HC A22/MF A01 CSCL 05H

A robot that can duplicate humam motion capabilities in such activities as balancing, reaching, lifting, and moving has been built and tested. These capabilities are achieved through the use of real time Model-Based Control (MBC) techniques which have recently been demonstrated. MBC accounts for all manipulator inertial forces and provides stable manipulator motion control even at high speeds. To effectively demonstrate the unique capabilities of MBC, an experimental robotic manipulator was constructed, which stands upright, balancing on a two wheel base. The mathematical modeling of dynamics inherent in MBC permit the control system to perform functions that are impossible with conventional non-model based methods. These capabilities include: (1) Stable control at all speeds of operation; (2) Operations requiring dynamic stability such as balancing; (3) Detection and monitoring of applied forces without the use of load sensors; (4) Manipulator safing via detection of abnormal loads. The full potential of MBC has yet to be realized. The experiments performed for this research are only an indication of the potential applications. MBC has no inherent stability limitations and its range of applicability is limited only by the attainable sampling rate, modeling accuracy, and sensor resolution. Manipulators could be designed to operate at the highest speed mechanically attainable without being limited by control inadequacies. Manipulators capable of operating many times faster than current machines would certainly increase productivity for many tasks. Author

N89-19885*# Rockwell International Corp., Downey, CA.
DESIGN GUIDELINES FOR REMOTELY MAINTAINABLE EQUIPMENT
MARGARET M. CLARKE and DAVOUD MANOUCHEHRI *In* NASA. Lyndon B. Johnson Space Center, 2nd Annual Workshop on Space Operations Automation and Robotics (SOAR 1988) p 495-497 Nov. 1988
Avail: NTIS HC A22/MF A01 CSCL 05H

The quantity and complexity of on-orbit assets will increase significantly over the next decade. Maintaining and servicing these costly assets represent a difficult challenge. Three general methods are proposed to maintain equipment while it is still in orbit: an extravehicular activity (EVA) crew can perform the task in an unpressurized maintenance area outside any space vehicle; an intravehicular activity (IVA) crew can perform the maintenance in a shirt sleeve environment, perhaps at a special maintenance work

station in a space vehicle; or a telerobotic manipulator can perform the maintenance in an unpressurized maintenance area at a distance from the crew (who may be EVA, IVA, or on the ground). However, crew EVA may not always be possible; the crew may have other demands on their time that take precedence. In addition, the orbit of the tasks themselves may be impossible for crew entry. Also crew IVA may not always be possible as option for equipment maintenance. For example, the equipment may be too large to fit through the vehicle airlock. Therefore, in some circumstances, the third option, telerobotic manipulation, may be the only feasible option. Telerobotic manipulation has, therefore, an important role for on-orbit maintenance. It is not only used for the reasons outlined above, but also used in some cases as backup to the EVA crew in an orbit that they can reach. Author

N89-19886*# Army Aviation Systems Command, Cleveland, OH.
AN EXPERT SYSTEM FOR RESTRUCTURABLE CONTROL
JONATHAN LITT *In* NASA. Lyndon B. Johnson Space Center, 2nd Annual Workshop on Space Operations Automation and Robotics (SOAR 1988) p 503-507 Nov. 1988
Avail: NTIS HC A22/MF A01 CSCL 05H

Work in progrss on an expert system which restructures and tunes control systems online in real-time is presented. The expert system coordinates the different methods involved in redesigning and implementing the control strategies due to plant changes. Author

N89-19890*# Essex Corp., Alexandria, VA.
SARSCEST (HUMAN FACTORS)
H. MCILVAINE PARSONS *In* NASA. Lyndon B. Johnson Space Center, 2nd Annual Workshop on Space Operations Automation and Robotics (SOAR 1988) p 541-552 Nov. 1988
Avail: NTIS HC A22/MF A01 CSCL 05H

People interact with the processes and products of contemporary technology. Individuals are affected by these in various ways and individuals shape them. Such interactions come under the label 'human factors'. To expand the understanding of those to whom the term is relatively unfamiliar, its domain includes both an applied science and applications of knowledge. It means both research and development, with implications of research both for basic science and for development. It encompasses not only design and testing but also training and personnel requirements, even though some unwisely try to split these apart both by name and institutionally. The territory includes more than performance at work, though concentration on that aspect, epitomized in the derivation of the term ergonomics, has overshadowed human factors interest in interactions between technology and the home, health, safety, consumers, children and later life, the handicapped, sports and recreation education, and travel. Two aspects of technology considered most significant for work performance, systems and automation, and several approaches to these, are discussed. Author

N89-20059*# Texas Southern Univ., Houston. Dept. of Home Economics.
COMPARISON OF SOVIET AND US SPACE FOOD AND NUTRITION PROGRAMS Final Report
SELINA AHMED *In* NASA, Lyndon B. Johnson Space Center, National Aeronautics and Space Administration (NASA)/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1988, Volume 1 16 p Feb. 1989
Avail: NTIS HC A09/MF A01 CSCL 06H

The Soviet Space Food and Nutrition programs are compared with those of the U.S. The Soviets established the first Space Food programs in 1961, when one of the Soviet Cosmonauts experienced eating in zero gravity. This study indicates that some major differences exist between the two space food and nutrition programs regarding dietary habits. The major differences are in recommended nutrient intake and dietary patterns between the cosmonauts and astronauts. The intake of protein, carbohydrates and fats are significantly higher in cosmonaut diets compared to astronauts. Certain mineral elements such as phosphorus, sodium and iron are also significantly higher in the cosmonauts' diets. Cosmonauts also experience intake of certain unconventional food and plant extracts to resist stress and increase stamina. Author

N89-20065*# Houston Univ., Clear Lake, TX. Div. of Life Sciences.
DEVELOPMENT OF AN ATMOSPHERIC MONITORING PLAN FOR SPACE STATION Final Report
DENNIS M. CASSERLY *In* NASA, Lyndon B. Johnson Space Center, National Aeronautics and Space Administration (NASA)/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1988, Volume 1 16 p Feb. 1989
Avail: NTIS HC A09/MF A01 CSCL 06K

An environmental health monitoring plan for Space Station will ensure crew health during prolonged habitation. The Space Station, Freedom, will operate for extended periods, 90+ days, without resupply. A regenerative, closed loop life support system will be utilized in order to minimize resupply logistics and costs. Overboard disposal of wastes and venting of gases to space will be minimal. All waste material will be treated and recycled. The concentrated wastes will be stabilized and stored for ground disposal. The expected useful life of the station (decades) and the diversity of materials brought aboard for experimental or manufacturing purposes, increases the likelihood of cabin contamination. Processes by which cabin contamination can occur include: biological waste production, material off-gassing, process leakage, accidental containment breach, and accumulation due to poor removal efficiencies of the purification units. An industrial hygiene approach was taken to rationalize monitoring needs and to identify the substances likely to be present, the amount, and their hazard. Author

N89-20071*# Montana State Univ., Bozeman. Dept. of Chemistry.
EVALUATION OF AVAILABLE ANALYTICAL TECHNIQUES FOR MONITORING THE QUALITY OF SPACE STATION POTABLE WATER Final Report
RICHARD D. GEER *In* NASA, Lyndon B. Johnson Space Center, National Aeronautics and Space Administration (NASA)/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1988, Volume 1 15 p Feb. 1989
Avail: NTIS HC A09/MF A01 CSCL 06K

To assure the quality of potable water (PW) on the Space Station (SS) a number of chemical and physical tests must be conducted routinely. After reviewing the requirements for potable water, both direct and indirect analytical methods are evaluated that could make the required tests and improvements compatible with the Space Station operation. A variety of suggestions are made to improve the analytical techniques for SS operation. The most important recommendations are: (1) the silver/silver chloride electrode (SB) method of removing I sub 2/I (-) biocide from the water, since it may interfere with analytical procedures for PW and also its end uses; (2) the orbital reactor (OR) method of carrying out chemistry and electrochemistry in microgravity by using a disk shaped reactor on an orbital table to impart artificial G force to the contents, allowing solution mixing and separation of gases and liquids; and (3) a simple ultra low volume highly sensitive electrochemical/conductivity detector for use with a capillary zone electrophoresis apparatus. It is also recommended, since several different conductivity and resistance measurements are made during the analysis of PW, that the bipolar pulse measuring circuit be used in all these applications for maximum compatibility and redundancy of equipment. Author

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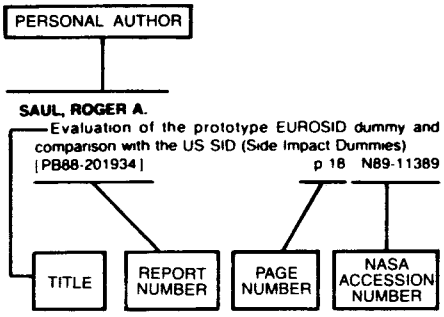

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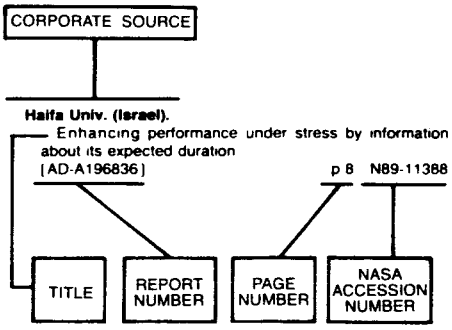

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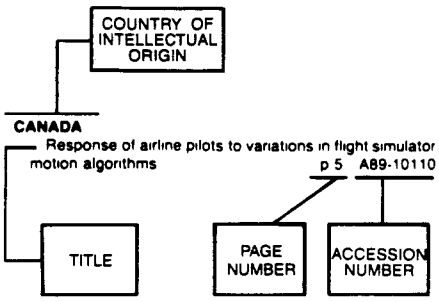

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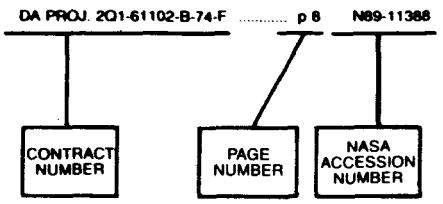

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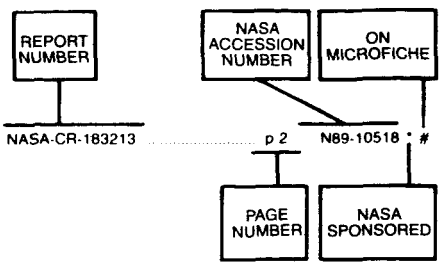

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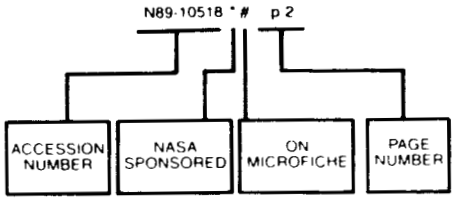

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